March 8, 2019
Terminal 4 Remedy

ANCHOR QEA

Pre-Remedial Design Investigation Work Plan

Prepared for U.S. Environmental Protection Agency, Region 10

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Prepared for
U.S. Environmental Protection Agency
Region 10
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Project Number: 050332-01.32
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ABBREVIATIONS

µg/kg	micrograms per kilogram
ADCM	acoustic Doppler current meter
Alternative F Mod	Alternative F Modified
ARAR	Applicable or Relevant and Appropriate Requirement
ASAOC	Administrative Settlement Agreement and Order on Consent
BEBRA	Bank Excavation and Backfill Remedial Action
BODR	Basis of Design Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CRD	Columbia River Datum
CSM	conceptual site model
cy	cubic yard
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DDx	the sum of DDT, DDD, and DDE
DEQ	Oregon Department of Environmental Quality
DSL	Oregon Department of State Lands
EE/CA	Engineering Evaluation/Cost Analysis
ESD	Explanation of Significant Differences
FMD	future maintenance dredging
FS	Feasibility Study
Kinder Morgan	Kinder Morgen Bulk Terminals, Inc.
LNAPL	light nonaqueous phase liquid
MS4	municipal separate storm sewer system
NAPL	nonaqueous phase liquid
NAVD88	North American Vertical Datum of 1988
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rule
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDI	pre-remedial design investigation
PDI Work Plan	*Pre-Remedial Design Investigation Work Plan*
PEC	probable effect coefficient

PeCDD	1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF	2,3,4,7,8-pentachlorodibenzofuran
per mg/kg-day	per milligrams per kilogram-day
Port	Port of Portland
Portland Harbor	Portland Harbor Superfund Site
Pre-RD Group Work Plan	*Work Plan: Portland Harbor Pre-Remedial Design Investigation Studies*
PTW	principal threat waste
RAL	remedial action level
RAO	remedial action objective
RD	Remedial Design
RI	Remedial Investigation
RM	river mile
ROD	Record of Decision
Sampling Plan	*Portland Harbor Superfund Site: Sampling Plan for Pre-Remedial Design, Baseline and Long-Term Monitoring*
SDU	Sediment Decision Unit
SMA	sediment management area
SOW	*Remedial Design Statement of Work*
SQAPP	*Sampling Quality Assurance Project Plan*
SWAC	surface-weighted average concentration
T4	Terminal 4
TADT	Technology Application Decision Tree
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TPH	total petroleum hydrocarbons
Upland Source Control Report	*Portland Harbor Upland Source Control Summary Report*
UPRR	Union Pacific Railroad
USEPA	U.S. Environmental Protection Agency
VCP	Voluntary Cleanup Program
VOC	volatile organic compound

1 Introduction

This *Pre-Remedial Design Investigation Work Plan* (PDI Work Plan) has been prepared by Anchor QEA, LLC on behalf of the Port of Portland (Port) for the Terminal 4 (T4) Action Area (as defined in the Administrative Settlement Agreement and Order on Consent [ASAOC] for Remedial Design [RD] for T4), which is located on the east bank of the Willamette River between river miles (RM) 4.2 and 5.0 in Portland, Oregon (Figure 1-1). This PDI Work Plan has been prepared under the ASAOC (Docket No. Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] 10-2004-0009), as amended on June 21, 2018, and in the *Remedial Design Statement of Work* (SOW; USEPA 2018a). Per the SOW, this PDI Work Plan presents pre-RD data gaps and the field investigations that will be used to fill data gaps for preliminary sediment management area (SMA) delineation consistent with the U.S. Environmental Protection Agency's (USEPA's) June 6, 2017 *Portland Harbor Superfund Site: Sampling Plan for Pre-Remedial Design, Baseline and Long-Term Monitoring* (Sampling Plan; USEPA 2017a); conceptual site model (CSM) refinement consistent with Section 14.2 of the Portland Harbor Superfund Site (Portland Harbor) Record of Decision (ROD; USEPA 2017b), post-ROD data gathering, and other information; and application of the Technology Application Decision Tree (TADT), which is Figure 28 of the Portland Harbor ROD.

Consistent with the SOW, a PDI Summary Report (see Section 5.1), to be delivered to USEPA 90 days after all validated PDI data are received, will evaluate whether the proposed data, along with existing data, provide a dataset sufficient to complete the Basis of Design Report (BODR) and Preliminary (30%) RD. USEPA may require additional data collection to supplement the PDI Summary Report.

1.1 Site Description and Summary of Selected Remedy

The T4 Action Area, also known as Sediment Decision Unit (SDU) RM 4.5E (herein termed the T4 SDU) within Portland Harbor, comprises Slip 1, Wheeler Bay, and Slip 3, as well as Berths 401 and 414, the area in between these two berths, and offshore of Slip 1, Wheeler Bay, and Slip 3 (Figure 1-1), which are summarized as follows:

- **Slip 1** is inactive with no existing water-dependent use but may be developed in the future for shallow-draft barge use.
- **Wheeler Bay** is an inactive bay with no existing water-dependent use and none anticipated in the future.
- **Slip 3** contains Berths 410 and 411, which is the main site of active marine operations serving deep-draft, ocean-going vessels with an 80% occupancy rate in the berths. Berths 410 and 411 are along the north side of Slip 3. Berth 410 is regularly maintenance dredged, most recently in 2017. Berth 411 was a primary focus of remedial dredging during the 2008 T4 Phase I Removal Action. The south side of Slip 3 is inactive.

- **Berth 401** is located downstream of the mouth of Slip 1 and is used as a lay berth and for the transfer of bulk liquid fertilizers to the International Raw Materials terminal facility. Berth 401 is regularly maintenance dredged, most recently in 2015.
- **Berth 414** is located upstream of the mouth of Slip 3 and is used to unload automobiles from deep-draft ocean-going vessels to the Auto Storage Area located in the southern portion of T4. A small removal action (approximately 0.1 acre) was performed downstream of Berth 414 during the T4 Phase I Removal Action to remove a localized deposit of total polycyclic aromatic hydrocarbons (PAHs) exceeding the PAH removal action level of 20 times the benthic probable effect coefficient (PEC; 22,800 micrograms per kilogram [μg/kg]).

The areas offshore of Slip 1, Wheeler Bay, and Slip 3 between Berths 401 and 414 are generally low in concentration (i.e., lower than remedial action levels (RALs) in the ROD) and in relatively deep water (i.e., greater than -20 feet Columbia River Datum [CRD]) and are likely affected by sedimentary processes in the adjacent navigation channel. These offshore areas serve as access to and from the active T4 berths.

The selected remedy for Portland Harbor is described in Section 14.2 of the Portland Harbor ROD (USEPA 2017b). Active remediation areas within Portland Harbor were identified as areas with sediment concentrations greater than RALs (ROD Table 21), which are ultimately intended to achieve ROD cleanup levels (ROD Table 17) over the long term. Alternative F Modified (Alternative F Mod), the selected remedy in the ROD, includes using the RALs from Alternative F (herein referred to as RALs) to determine SMAs where active remediation (e.g., dredging or capping) should occur.

SMAs were identified in the ROD by USEPA using the Portland Harbor Remedial Investigation (RI) data contained in the Feasibility Study (FS) database (USEPA 2017b). The SMAs presented in the ROD for the T4 SDU (ROD SMAs) are shown in Figure 1-2. In this PDI Work Plan, SMAs are shown only within the Portland Harbor Study Area boundary (i.e., at or below +13 feet North American Vertical Datum of 1988 [NAVD88]) as defined in the Portland Harbor FS (USEPA and CDM Smith 2016). During the RD, SMAs will be further refined using additional available T4 data, as well as data collected under this PDI Work Plan consistent with Section 14.2 of the ROD (see the "Post-ROD Data Gathering and Other Information" subsection*)* and USEPA's June 6, 2017 draft Sampling Plan (USEPA 2017a). In addition, the CSM will be refined consistent with Section 14.2 of the ROD, and remedial technologies will be selected using USEPA's ROD Figure 28 (TADT; reproduced as Figure 1-3 in this report), consistent with the design criteria outlined Section 14.2.9 of the ROD.

Additional considerations regarding the use of USEPA's TADT at the T4 SDU are described in Section 4.

On December 19, 2017, USEPA signed an ASAOC with the "Pre-RD Group" for a pre-remedial design investigation (PDI) and baseline sampling throughout Portland Harbor (CERCLA Docket No. 10-2018-

0236; USEPA 2018a). The Pre-RD Group consists of four of the Potentially Responsible Parties for Portland Harbor: Arkema, Inc.; Evraz, Inc. NA; Schnitzer Steel Industries, Inc.; and The Marine Group, LLC (USEPA 2018a). The *Work Plan: Portland Harbor Pre-Remedial Design Investigation Studies* (Pre-RD Group Work Plan; Geosyntec 2017) outlines sampling to be conducted throughout Portland Harbor, including the T4 SDU, and includes a new bathymetric survey and surface and subsurface sediment sampling, among other sampling activities. The Pre-RD Group began implementing the harbor-wide PDI Work Plan in 2018. Sediment sampling and a new bathymetric survey completed by the Pre-RD Group were considered in the evaluation of data gaps for delineating SMAs at the T4 SDU and are further discussed in Section 5.

1.2 Purpose and Objectives

Consistent with the SOW, the purpose of the PDI is to identify and address data gaps by conducting field investigations to develop the BODR, RD Work Plan, and RD. More specifically, the purpose of this PDI Work Plan is to evaluate existing data for the T4 SDU and identify data gaps for delineating SMAs, refine the CSM, and apply the TADT (Figure 28 of the ROD; Figure 1-3) consistent with the ROD (USEPA 2017b). In Figure 1 of the USEPA draft Sampling Plan, which identified USEPA's recommended sediment core locations for pre-RD characterization, the T4 SDU was recognized (in Note 2) as having existing data that could be used to delineate the horizontal and vertical extent of the SMA, and that "the AOC performing party" (in this case, the Port) will "need to determine the need and quantity for any additional cores to inform the allocation and/or data gaps during the design phase." Consistent with USEPA's recommendation, data gaps and recommended pre-design investigations for the T4 SDU are described in this PDI Work Plan.

1.3 Document Organization

The remainder of this document is organized into the following sections:

- Section 2: Sediment Management Area Delineation
- Section 3: Conceptual Site Model
- Section 4: Selection of Remedial Technologies
- Section 5: Pre-Remedial Design Investigation
- Section 6: References

The following appendices are attached to this document:

- Appendix A: Sampling Quality Assurance Project Plan
- Appendix B: Health and Safety Plan
- Appendix C: Supporting Upland/Source Control Documentation
  - Appendix C-1: Riverbank Soil Samples in Slip 1 and Wheeler Bay
  - Appendix C-2: Riverbank Soil Samples in Slip 3

2 Sediment Management Area Delineation

One of the primary objectives of the PDI is to collect additional surface and subsurface sediment data in the T4 SDU to delineate SMAs for the selected remedy. Surface and subsurface sediment data will be collected to better define the horizontal and vertical extent of contamination for T4 focused contaminants of concern (COCs; see Section 2.1) and to better characterize current surface sediment conditions where existing data are outdated and may no longer be representative of current surface sediment conditions. SMAs identified in the ROD (Figure 1-2) were delineated based on the RALs, principal threat waste (PTW) thresholds,[1] and navigation channel RALs (ROD Table 21, reproduced as Table 2-1 in this report) and represent areas where active remediation was expected to be required to reduce risk based on the information available at that time. Per the ROD, navigation channel RALs only apply to the navigation channel areas in Portland Harbor and are not applied in the T4 SDU.

A summary of ROD SMAs, existing sediment data, and remaining data gaps to support refinement of SMA boundaries at the T4 SDU are described in this section.

2.1 Sediment Management Areas Identified in the ROD

As described previously, ROD SMAs, as defined by RALs (Table 2-1), were identified in the ROD using the Portland Harbor RI data contained in the FS database (USEPA 2017b). The T4 SMAs presented in the ROD are shown in Figure 1-2. Per the ROD, the focused COCs used to define the SMA boundaries encompassed most of the spatial extent of sediment contaminants posing the majority of the risks as identified in the baseline risk assessments for Portland Harbor. Because it was difficult to design a range of alternatives for 64 COCs that have different distributions in various media throughout Portland Harbor, the FS alternatives were developed using COCs that were the most widespread and posed the greatest risk, called focused COCs. These focused COCs were developed by evaluating co-location of all COCs, their toxicity, and significance in the risk assessments as well as other factors outlined in the RI (USEPA 2017b). The focused harbor-wide COCs that were used to define SMA boundaries throughout Portland Harbor are as follows:

- Total PAHs
- Polychlorinated biphenyls (PCBs)
- DDx (the sum of dichlorodiphenyltrichloroethane [DDT], dichlorodiphenyldichloroethane [DDD], and dichlorodiphenyldichloroethylene [DDE])

[1] PTW is defined in the ROD as "a source material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air or that act as a source for direct exposure" (USEPA 2017b). PTW is further categorized as "source material" PTW (i.e., nonaqueous phase liquid [NAPL] within the sediment bed), "highly toxic" PTW (i.e., exceeding a 10^{-3} cancer risk based on fish consumption), or as "PTW that cannot be reliably contained" (e.g., highly mobile) or would present significant risk to human health or the environment should exposure occur (USEPA 2017b).

- Dioxins/furans (specifically 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD]; 1,2,3,7,8-pentachlorodibenzo-p-dioxin [PeCDD]; and 2,3,4,7,8-pentachlorodibenzofuran [PeCDF])

The ROD SMAs within the T4 SDU, and the large majority of site risk, are defined by concentrations of total PAHs and PCBs that exceed RALs. These are the site-specific focused COCs that USEPA identified for T4, per Table 24 of the ROD. Historically, PAH contamination within the T4 SDU was derived from two principal sources: former offloading of pencil pitch (a solid hydrocarbon product used in the aluminum industry) and fuel seepage from a former pipeline connecting a fueling dock on the Willamette River to former aboveground storage tanks on the uplands. The presence of pencil pitch is a unique form of PAH contamination that has been shown to have reduced bioavailability and toxicity compared to other more common forms of PAHs found harbor-wide (Hart Crowser 2000; Paine et al. 1996). There is one small area of highly toxic PTW based on one isolated surface sediment sample with a total PCB concentration (1,000 µg/kg) exceeding the PTW threshold of 200 µg/kg. At the T4 SDU, there is no PTW designated as source material (i.e., nonaqueous phase liquid [NAPL]) and no PTW that cannot be reliably contained identified in the ROD.

In October 2018, USEPA released for public comment the *Proposed Explanation of Significant Differences* (ESD; USEPA 2018c) for the ROD. The Proposed ESD updates certain sediment cleanup levels and RALs based on the January 2017 USEPA updates to the human health carcinogenic toxicity for benzo(a)pyrene.[2] If adopted, this revision could impact the cleanup process at T4, which is largely driven by carcinogenic PAHs in much of the SDU, including delineation of SMAs requiring active remediation. Potential implications of a final ESD within the T4 SDU include reduction of the footprint of the ROD SMAs, most notably in Slip 3, Wheeler Bay, and at the head of Slip 1. Any changes to the sampling approach (Section 5) as a result of the final ESD will be documented in a Work Plan Addendum or Deviation Form, in consultation with USEPA.

2.2 Review of Existing Data within the T4 SDU

This section provides an overview of existing sediment data that were used to define SMAs in the ROD within the T4 SDU. Multiple sediment investigations have been conducted at the T4 SDU since 1997; a summary of these data sources is provided in Table 2-2. The nature and extent of contamination in surface sediment (defined in the ROD as 0 to 30 centimeters [cm] or 0 to 1 foot below mudline[3]) and subsurface sediment (samples with end depths greater than 30 cm [1 foot] below mudline) are

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[2] In USEPA's January 19, 2017 updated *Toxicological Review of Benzo(a)pyrene (CASRN 50-32-8): Executive Summary Integrated Risk Information System (IRIS)* (USEPA 2017c), the oral cancer slope factor decreased from 7.3 per milligrams per kilogram-day (per mg/kg-day) to 1 per mg/kg-day.

[3] The definition of surface sediment in the Portland Harbor RI/FS is different than the ROD definition. In the RI/FS, surface sediment was defined as typically 0 to 30 cm below mudline, but no more than 40 cm below mudline. This difference does not impact existing surface sediment data in the T4 SDU because samples categorized as "surface sediment" in the RI/FS were collected within the top 30 cm below the mudline so are also categorized as "surface sediment" based on the ROD definition.

evaluated for the T4 SDU in this section and are based almost exclusively on existing data from USEPA's FS database (USEPA 2016, Appendix A). The only additional data considered in this report are two 2015 post-maintenance dredging surface sediment samples (0 to 10 cm [0 to 0.3 foot]) from the Berth 401 maintenance dredge (Hart Crowser 2015) area and six Berth 410 maintenance dredging samples, including three 2016 pre-maintenance dredging sediment samples (i.e., "Z-layer" samples; still in situ at 0 to 60 cm [0 to 2 foot]) and three 2017 post-maintenance dredging sediment sample results characterizing the top 0 to 10 cm (0 to 0.3 foot) of sediment in the Berth 410 maintenance dredge area in Slip 3 (Hart Crowser 2017, 2018). These samples are shown on maps and in summary tables for reference, and the post-dredge data will be incorporated in the next iteration of SMA delineation.

Based on discussions with USEPA, both surface and subsurface data will be used to define the T4 SMAs. Future design evaluations will consider subsurface data in terms of depth and elevation of contamination, concentration profiles and time trends, evidence for any ongoing natural recovery, and the potential for buried contamination to impact surface sediments or porewater in the zone of biological exposure.

2.2.1 Terminal 4 Focused Contaminants of Concern

The focused COCs that were used to define SMAs in the ROD (i.e., the harbor-wide focused COCs, which are total PAHs, PCBs, DDx, and dioxins/furans) are herein used to evaluate sediment data gaps and to refine SMA boundaries for the T4 SDU. As stated previously, concentrations of total PAHs and PCBs in sediments have had the greatest influence on the extents of the existing SMAs at the T4 SDU and are identified in the ROD as the site-specific focused COCs for T4.

2.2.2 Nature and Extent of Contamination

Nature and extent of contamination for the focused COCs at T4 is summarized in the following subsections.

2.2.2.1 Surface Sediment

Existing surface sediment samples for the T4 SDU are shown in Figure 2-1. More than 100 surface sediment samples have been collected at the T4 SDU throughout the past 20 years. Nearly all of the surface sediment data, however, are more than 10 years old, and some are more than 20 years old and may no longer be representative of current surface sediment conditions. As further discussed in Section 3.3.2, at least 30 cm (1 foot)of new sediment has accumulated since many of these samples were collected; when compared to the depth over which surface sediments were evaluated in the Portland Harbor (30 cm [1 foot]), natural recovery through deposition may be occurring but would need to be verified through additional characterization and a multiple-lines-of-evidence analysis in the BODR.

A summary of T4 surface sediment data for the harbor-wide focused COCs is provided in Table 2-3. Sediment summary statistics, including the number of samples and percentage of samples that exceed RALs for each harbor-wide focused COC in T4 surface sediments are presented in Table 2-4.

As previously noted in this section, post-maintenance dredging surface sediment sample results characterizing the top 0 to 10 cm (0 to 0.3 foot) of sediment have been recently collected in the Berth 410 maintenance dredge area (three samples) and the Berth 401 maintenance dredging area (two samples). These samples are shown in Figure 2-1 and Tables 2-3 and 2-4 but are not part of the FS database.

PAHs

As shown in Figure 2-2, historical surface sediment samples provide good spatial coverage of PAH data throughout the T4 SDU. Of 119 surface samples analyzed for total PAHs, 48 samples (40%) exceeded the RAL for PAHs (13,000 µg/kg). Most PAH exceedances occurred in Slip 3 adjacent to former pencil pitch offloading operations (i.e., adjacent to Berth 411). Elevated PAH levels were also identified in the southeast corner of Wheeler Bay, and lower level exceedances (generally less than two times the RAL) were found in some parts of Slip 1, including a portion of the area beneath Pier 2. As noted in Section 2.1, these areas may be further reduced if the increased total PAH RAL in the Proposed ESD (USEPA 2018c) is adopted.

Although the PAH contours shown in Figure 2-2 are from the ROD and do not reflect the recent post-dredge surface sediment results collected in front of Berths 401 and 410, these five samples were all below the RAL for PAHs.

PCBs

There is also good spatial coverage of PCB data in surface sediments at the T4 SDU (Figure 2-2). Of 66 surface samples analyzed for PCBs, 12 samples (18%) exceeded the RAL for total PCBs (75 µg/kg). Most PCB exceedances were identified in Slip 1, including the area beneath Pier 2, and were generally low-level exceedances less than two times the RAL. Elevated PCB levels in surface sediment were also present in more localized areas adjacent to the navigation channel and in Slip 3, including an underpier sample adjacent to the former Pier 5 structure at the head of Slip 3. One sample, located near the southwest end of Slip 1 (collected in 2004), also exceeded the PTW highly toxic threshold for PCBs (200 µg/kg). As noted in Appendix A of the Portland Harbor FS (USEPA 2016), total PCBs represent either the sum of individual PCB congeners, when congener-based results were available, or the sum of PCB Aroclors. Most of the PCB data for the T4 SDU (i.e., for 61 of 66 samples) are PCB Aroclor data.

Although the PCB contours shown in Figure 2-2 are from the ROD and do not reflect the recent post-dredge surface sediment results collected in front of Berths 401 and 410, these five samples were all below the RAL for PCBs.

DDx

As shown in Figure 2-3, historical surface sediment samples provide good spatial coverage of DDx data, including underpier areas, throughout the T4 SDU. Of 76 surface samples analyzed for DDx, none exceeded the RAL for total DDx (160 μg/kg). The recent post-dredge surface sediment results collected in front of Berths 401 and 410 were also below the RAL for DDx.

Dioxins/Furans

Limited surface sediment data for dioxins/furans are available for the T4 SDU. Historical surface sediment samples with dioxin/furan data are shown in Figure 2-3. Of the seven samples analyzed for dioxins/furans, none exceeded the RAL for PeCDD (0.0008 μg/kg), PeCDF (0.2 μg/kg), or TCDD (0.0006 μg/kg).

2.2.2.2 Subsurface Sediment

Existing subsurface sediment samples for the T4 SDU are shown in Figures 2-4 through 2-7. A total of 231 subsurface sediment samples have been collected from 67 locations within the T4 SDU in the past 20 years. Unlike data for surface sediment, which may be replaced over time in part or in whole by more recent sediment, subsurface data remain relevant and useful for RD purposes. Although the sample depths compared to mudline may change in response to ongoing sediment deposition, the elevations of contaminated subsurface layers are expected to be relatively stable. A summary of subsurface sediment data for harbor-wide focused COCs is provided in Table 2-5. Summary statistics for each harbor-wide focused COC are provided for subsurface sediments in Table 2-4.

PAHs

Extensive PAH data exist for subsurface sediment at the T4 SDU. Of the 67 subsurface core locations where samples were analyzed for PAHs, 19 locations (28%) have core intervals that exceeded the RAL. The majority of the PAH exceedances were from samples collected in Slip 3 (Figure 2-4) and were from the top 5 feet below the mudline. In Wheeler Bay, samples from three core locations exceeded the RAL, mainly occurring in the southeast corner adjacent to Slip 3. In Slip 1, only one subsurface sample exceeded the RAL.

All core locations with RAL exceedances by PAHs are bounded by at least one deeper sample interval that is below the RAL, with the exception of the core locations summarized in Table 2-6 and shown in Figures 2-8 and 2-9.

PCBs

Of 47 subsurface core locations where samples were analyzed for PCBs throughout the T4 SDU, 20 locations (43%) exceeded the RAL (Figure 2-5). All core locations with RAL exceedances by PCBs have at least one deeper sample interval that is below the RAL, with the exception of the core locations summarized in Table 2-6 and shown in Figures 2-8 and 2-9. In Slip 1, PCB RAL exceedances typically occurred within the top 5 feet below the mudline and were vertically bounded by one or more deeper samples that were below the RAL. In Wheeler Bay, elevated PCBs were detected at multiple intervals down to 17 feet below the mudline; however, these deeper samples (further discussed in Section 2.3) are outside the ROD SMAs, and based on existing data, deeper samples are overlain by 3 to 5 feet of sediment that does not exceed the RAL (Table 2-6). At one location near the head of Slip 3, PCBs exceeded the RAL in samples from the top 10 feet below the mudline and were typically co-located with PAH exceedances.

DDx

Of 47 subsurface core locations where samples were tested for DDx throughout the T4 SDU, only two subsurface samples exceeded the RAL for DDx (Figure 2-6). Sample location PI-09, located just south of Slip 3 (and outside of the ROD SMA), had a DDx concentration above the RAL in the 1- to 2-foot sample interval, and there were no deeper samples. Sample VC-29, located near the head of Slip 3 and co-located with higher magnitude PCB and PAH exceedances, had a DDx concentration above the RAL in the 1- to 3-foot sample interval. All deeper samples at this location were below the RAL for DDx.

Dioxins/Furans

Dioxin/furan data are available for the three Berth 410 (Slip 3 area) pre-maintenance dredging Z-layer samples collected in 2016, which are not currently included in USEPA's FS database (Figure 2-7). Concentrations in all three samples (each collected from 0 to 2 feet below the mudline) were below the RALs for PeCDD (0.0008 µg/kg), PeCDF (0.2 µg/kg), and TCDD (0.0006 µg/kg). These three pre-maintenance dredging Z-layer samples from Berth 410 provide information to support the lack of dioxin/furan RAL exceedances at depth but will not be used in SMA delineation given the uncertainty in the representativeness of these samples to characterize post-dredging surface sediment conditions. No other subsurface dioxin/furan data are available for the T4 SDU.

2.3 Data Gaps

The following is a summary of data gaps for SMA delineation at T4. Additional details regarding subsurface data gaps are provided in Table 2-6.

- **Current Surface Sediment Conditions.** Abundant surface sediment data exist for the T4 SDU. However, these data are 10 to 20 years old, and due to the prevailing sedimentation rates at T4 (see Section 3.3.2), ongoing natural recovery may be occurring such that these surface sediment samples may not represent current conditions. As such, surface sediment data to characterize current surface sediment concentrations throughout the T4 ROD SMA represent a data gap for SMA delineation. Multiple lines of evidence (e.g., sedimentation rates, sediment concentration trends, and the level of statistical certainty surrounding trends) will be evaluated in the BODR to verify that natural recovery is taking place at T4.

- **Underpier Surface and Subsurface Sediment Conditions.** Underpier samples from the Pier 1 area of Slip 1 and Berth 410 area of Slip 3 were all below RALs. Underpier samples from the Pier 2 area in Slip 1 and the Berth 411 area near the head of Slip 3 exceeded the RALs for PAHs and PCBs, but all were below the RAL for DDx. Because of these exceedances, underpier surface sediment data to characterize current surface sediment concentrations in portions of the Pier 2 area of Slip 1 and Berth 411 area of Slip 3 represent a data gap for SMA delineation, even though the mapping of the T4 SMA in the ROD does not extend currently under the piers. Subsurface sediment conditions in underpier areas are also considered a data gap for SMA delineation.
- **Extent of Surface PAH Contamination.** Surface sediment samples provide good spatial coverage of PAH data throughout the T4 SDU. Most PAH exceedances occurred in Slip 3 adjacent to former pencil pitch offloading operations, in the southeast corner of Wheeler Bay, and in a few localized areas of Slip 1, and they are laterally bound by samples below the RAL. However, T4 PAH distributions may have been modified by ongoing sedimentation and natural recovery, as well as localized erosion by propwash and flood events, and should be reassessed in consideration of recent revisions to cPAH toxicity (USEPA 2017c) as described in the Proposed ESD (USEPA 2018c). In addition, PAHs are one of the focused COCs for the T4 SDU. As such, surface sediment data to characterize the extent of current surface PAH contamination are a data gap for SMA delineation.
- **Extent of Subsurface PAH Contamination.** Substantial PAH data exist for subsurface sediment in the T4 SDU. All core locations with RAL exceedances by PAHs were vertically bounded by at least one deeper sample interval below the RAL, with the exception of a few locations in Slip 3 (Table 2-6 and Figures 2-8 and 2-9). However, as shown in Figure 2-9, some of the unbounded Slip 3 cores are adjacent to cores that have deeper samples below the RAL; therefore, they do not represent a PAH subsurface data gap. Subsurface data to confirm the depth of contamination in cores with unbounded PAH contamination represent a data gap for SMA delineation.
- **Extent of Surface PCB Contamination.** Existing surface sediment samples provide good spatial coverage of PCB data throughout the T4 SDU. Most PCB exceedances occur in Slip 1 and were laterally bound by samples that are below the RAL. However, T4 PCB distributions may have been modified by ongoing sedimentation and natural recovery, as well as localized erosion by propwash and flood events, and may not represent current conditions. In addition, PCBs are one of the focused COCs for the T4 SDU. As such, surface sediment data to characterize the extent of current surface PCB contamination are a data gap for SMA delineation.
- **Extent of PCB-Related PTW.** One sample (surface sediment), located near the southwest end of Slip 1, exceeded the PCB threshold for highly toxic PTW and was not well bounded by neighboring samples. The extent of PCB PTW in this portion of Slip 1 is therefore a data gap for SMA delineation. A total PCB PTW area is shown on the northern (downstream) boundary of Berth 401 (Figure 2-2). This apparent PTW area is based on a data extrapolation artifact from the adjacent downriver site. No existing surface sediment data near Berth 401 within the

T4 SDU exceeds the PTW threshold. The Pre-RD group collected two surface sediment samples in this area and two additional post-dredge samples are available from a recent Berth 401 maintenance dredging event. Though existing data are below the PCB PTW threshold, additional surface and subsurface sediment sampling to verify the extent of potential PCB contamination near Berth 401 is proposed.

- **Extent of Subsurface PCB Contamination.** There is a significant amount of subsurface data for PCBs within the T4 SDU. All core locations with RAL exceedances by PCBs were vertically bounded by at least one deeper sample interval below the RAL, with the exception of a few locations in Wheeler Bay and Slip 3 (Table 2-6 and Figures 2-8 and 2-9). Because the PCB exceedances in the Wheeler Bay locations (VC-20 and VC-21) are covered by 3 to 5 feet of sediment that is below the RAL, they do not represent a data gap for SMA delineation. Areas of buried contamination (such as these examples) will be further evaluated as part of the BODR in consideration of their physical and chemical stability, as discussed in Section 5.2. Additional subsurface PCB data will be collected at a core location adjacent to the navigation channel in Wheeler Bay to better understand the nature and extent of PCB impacts within the ROD SMA. PCB exceedances at the head of Slip 3 are not vertically bounded and, therefore, represent a data gap for SMA delineation.
- **Extent of Surface and Subsurface DDx Contamination.** There were no exceedances of the DDx RAL in surface sediment in the T4 SDU; as such, surface sediment DDx data does not represent a data gap for SMA delineation, and collection of additional DDx data in surface sediments is not warranted. There were two isolated DDx RAL exceedances in subsurface sediment: at VC-29, near the head of Slip 3, and at PI-09, just upstream of Slip 3. The DDx exceedance at Station VC-29 (i.e., at the 1- to 3-foot depth interval) is bounded by multiple deeper intervals that are below the RAL; however, additional DDx testing at this location is proposed because of the shallow RAL exceedances. At PI-09, which is outside of the ROD SMA, a shallow historical DDx RAL exceedance (i.e., from 1 to 2 feet below mudline) is unbounded at depth. As such, a core has been proposed near PI-09 to verify the depth of DDx impacts in this area. Additional subsurface sediment DDx data in these two areas is a data gap for SMA delineation.
- **Extent of Surface and Subsurface Dioxin/Furan Contamination.** There were no RAL exceedances of dioxins/furans in surface sediment data; however, the number of samples with dioxin/furan data in the T4 SDU is limited. There is no reason to believe that dioxins/furans are COCs at T4, based on the nature of historical terminal operations and limited existing data. Nevertheless, collection of additional dioxin/furan data in surface sediments is warranted to verify surface sediment concentrations based on a more robust dataset. Therefore, approximately 25% of surface samples will be analyzed for dioxins/furans, with material from the remaining samples to be archived, as discussed further in Section 5.2. There are also limited subsurface data for dioxins/furans at T4; therefore, collection of subsurface

dioxins/furans data may be warranted if RAL exceedances are found in any newly collected surface sediments.

3 Conceptual Site Model

The CSM for the T4 SDU as it is currently understood is presented in this section. The following information represents a more refined and site-specific CSM for the T4 SDU in comparison to the more general information presented in the FS and ROD for Portland Harbor. Emphasis is placed on those aspects of the CSM that are most relevant for preliminary remedial technology assignments for the purposes of developing a Preliminary (30%) RD. Information regarding site conditions (land ownership, bathymetry, presence of debris, shoreline features, and navigation requirements), geology and hydrogeology, sedimentary processes (hydrodynamic conditions, sedimentation rates, and sediment stability), the status of upland and in-water source control actions, and risk exposure pathways are discussed in this section.

3.1 Site Conditions

Site conditions, including land ownership, bathymetry, presence of debris, shoreline features, and navigational requirements for the T4 SDU, are presented in this section.

3.1.1 Land Ownership

The uplands and interior portions of the submerged aquatic lands at T4 are owned by the Port. The State of Oregon owns the submerged aquatic lands in Wheeler Bay and the outer portions of Slips 1 and 3 (Figure 3-1). State-owned aquatic lands are managed by the Oregon Department of State Lands (DSL). The placement of caps or other in situ remedial technologies requiring long-term maintenance on State-owned lands will likely require an easement or access authorization from DSL according to Oregon Administrative Rules (OAR) 141–145.

3.1.2 Current and Future Site Use and Navigational Requirements

The current and future site use and navigational requirements for T4 include the following:

- **Slip 1** is inactive with no existing water-dependent use but may be developed in the future for shallow-draft barge use.
- **Wheeler Bay** is an inactive bay with no existing water-dependent use and none anticipated in the future.
- **Slip 3** contains Berths 410 and 411, which are the main site of active marine operations, serving deep-draft ocean-going vessels with an 80% occupancy rate. Berths 410 and 411 are located on the north side of Slip 3 and are leased by Kinder Morgan Bulk Terminals, Inc. (Kinder Morgan), for soda ash offloading operations. The south side of Slip 3 (former Pier 5) is inactive. There are no plans for marine terminal operations in the former Pier 5 area in Slip 3.
- **Berth 401** faces the main stem river downstream of the mouth of Slip 1 and is used as a lay berth and for the transfer of bulk liquid fertilizers to the International Raw Materials terminal facility.

- **Berth 414** faces the main stem river upstream of the mouth of Slip 3 and is used to unload automobiles from deep-draft ocean-going vessels to the Auto Storage Area located in the southern portion of T4.

The areas offshore of Slip 1, Wheeler Bay, and Slip 3 between Berth 401 and Berth 414 are generally low in concentration (i.e., lower than RALs in the ROD) and in relatively deep water (i.e., greater than -20 feet CRD) and are likely affected by sedimentary processes in the adjacent navigation channel. These offshore areas serve as access to and from the active T4 berths.

To facilitate safe vessel access, Berth 410 is periodically dredged to maintain its authorized elevation of -42 +2 feet CRD. Maintenance dredging at Berth 410 occurred most recently in 2017. After dredging, a sand cover was placed over a portion of the post-dredge surface that exceeded dredged material regulatory criteria (Hart Crowser 2017). Dredging at Berth 411 was last conducted during the T4 Phase I Removal Action in 2008 (Anchor QEA et al. 2009). Berth 401 is regularly maintenance dredged, most recently in 2015; no concerns were identified for the post-dredge surface at Berth 401.

Activities related to the T4 Phase I Removal Action included extensive remedial dredging at Berth 411 and more localized removal actions in the center of Slip 3 and downstream of Berth 414 to remove isolated deposits of total PAHs exceeding the PAH removal action level of 20 times the benthic PEC (22,800 µg/kg).

3.1.3 Bathymetry

Slips 1 and 3 were originally constructed to serve deep-draft ocean-going vessels. The current mudline elevations in both slips are below -30 feet CRD. Berths 410 and 411 on the north side of Slip 3 are the Port's most active berths in Portland Harbor and are maintained at -44 feet CRD (-42 feet CRD with a 2-foot overdredge allowance) (PSET 2017). These berths are contiguous with the federal navigation channel and exhibit similar physical characteristics (Figure 3-1). Wheeler Bay is shallower, generally between 0 and -20 feet CRD, and is not used for maritime operations, not currently or for most of its history. Wheeler Bay sediments may have become contaminated either by sediments drifting in under the finger pier from Slip 3 or during the historical filling of the bay. Wheeler Bay was originally intended to be Slip 2, but its maritime use was abandoned early in the development of the terminal, and the area was partially reclaimed with hydraulic dredged material from other parts of the terminal. The two main hydraulic disposal and filling events occurred in 1948 (from the dredging of an oil dock south of Slip 3) and in 1957 through 1958 (in conjunction with the widening of Slip 3) (BBL 2005, Appendix A).

Slips 1 and 3 have steep riprapped side slopes, ranging from 1.5-to-1 to 3-to-1, which were designed to accommodate current and former berthing needs. In contrast, the waterway floors are relatively flat. Wheeler Bay is characterized by gentler slopes ranging from 10-to-1 to 30-to-1.

The Pre-RD Group recently collected harbor-wide bathymetry data as part of their 2018 baseline sampling effort (Geosyntec 2017; see Section 1). Bathymetry data collected in 2004 and 2009 are also available. The bathymetry data for T4 recently collected as part of the 2018 harbor-wide baseline sampling effort are adequate for the purposes of the BODR and will be further evaluated in that document in terms of utility for RD.

3.1.4 Debris

A high-resolution side-scan sonar survey was conducted on the Lower Willamette River in 2008 to characterize the approximate distribution of debris in the river channel and along both banks of the river (Anchor QEA 2009). The side-scan sonar survey captured portions of Wheeler Bay but did not include Slips 1 and 3 of the T4 SDU.

As shown in Figure 5.1-2 of the Portland Harbor FS (USEPA 2016), debris and pilings were identified in outer Wheeler Bay and at the outlet of Slip 3 near the navigation channel. In addition, several pilings/dolphins and an old dock structure were identified along the northern shoreline of Wheeler Bay. Though not captured in the 2008 survey, a large field of more than 1,000 remnant piles from the former Pier 5 structure exists along the south bank of Slip 3.

An evaluation on whether an updated shoreline structures and conditions survey is warranted will be part of the BODR analysis.

3.1.5 Shoreline Conditions

A habitat assessment was conducted in 2006 to support mitigation planning associated with Phase 1 Removal Action activities at T4. The habitat assessment suggests that side slopes at Slips 1 and 3 are steep and riprapped, with no beaches (public or otherwise), negligible shallow water habitat, and low habitat value. Habitat characteristics that were considered during the assessment included physical characteristics (i.e., water depth, substrate, slope, presence of off-channel/slack water, and presence of shoreline modifications) and biological characteristics (i.e., presence of cover and presence of riparian vegetation) (Anchor Environmental 2006). Overwater structures include Berths 410 and 411 in Slip 3, Berths 401 and 414 facing the Willamette River on the north and south ends of the terminal, respectively, and the inactive piers (Pier 1 and Pier 2) in Slip 1. As noted in Section 3.1.3, a large field of remnant piles is present along the south bank of Slip 3 (from the former Pier 5), creating a potential obstruction for remedial actions in this area.

The Wheeler Bay shoreline was regraded and stabilized in 2008 as part of the T4 Phase I Removal Action to contain and prevent the erosion of contaminated materials into the bay (Anchor QEA 2009 et al.). The shoreline was contained and stabilized using a combination of armor rock and bioengineered features, including willow plantings and large woody debris. The Port is currently discussing adaptive management activities with USEPA and other stakeholders that would be implemented in 2019 along the Wheeler Bay shoreline to address pockets of isolated surface erosion that exposed contaminated material in the willow planting zone (between +15 and +20 feet National Geodetic Vertical Datum). The erosion occurred when water levels reached the planted willow zone during high water that occurred during spring runoff or snowmelt events in 2017 and 2018. Similar areas of surface erosion exposing potentially contaminated material previously occurred in 2010 and 2011, when water levels reached the planted willow zone, were addressed by adding armoring and large woody debris to the shoreline. The adaptive management activities currently being discussed would occur over a larger area than where isolated surface erosion has occurred to be proactive and make the shoreline more resilient against erosion caused by future high water levels (Anchor QEA 2018).

3.2 Site Geology and Hydrogeology

A detailed description of the T4 geology and hydrogeology is presented in the *Characterization Report, Terminal 4 Early Action* (BBL 2004) and is summarized in Appendix D of the *Terminal 4 Early Action Engineering Evaluation/Cost Analysis* (EE/CA; BBL 2005) and Appendix A of the *Terminal 4 Confined Disposal Facility Design Analysis Report* (Anchor QEA et al. 2011). The stratigraphic sequence at T4 consists of the following:

- **Upland fill material**, generally consisting of medium to fine sand, ranging in thickness from about 5 to 40 feet
- **Modern sedimentary deposits**, consisting of silt, sandy silt, and silty sand, with historical accumulations of about 1 to 5 feet following the initial dredging of the waterways and generally increasing in thickness toward the interior of the slips
- **Unconsolidated alluvial deposits**, consisting of fine sand west of the former shoreline and interbedded layers of gravel, sand, silt, and clay to the east of the former shoreline, ranging in thickness from 120 to 160 feet
- **Troutdale gravel deposits**, encountered at an elevation of approximately -114 to -168 feet CRD (i.e., well below any depths of concern for sediment remediation)

The regional groundwater flow direction is toward the Willamette River. In nearshore locations, groundwater in upland fill material and unconsolidated alluvial deposits is in direct hydraulic connection with the river, and groundwater elevations respond to changes in river stage.

Direct measurements of groundwater seepage rates to the river were taken during the RI in the Portland Harbor Study Area but not within the T4 SDU. Ultrasonic seepage meter measurements were taken primarily during the season of presumed maximum groundwater flux (high upland groundwater levels and low river stage). Daily average measurements ranged from -18.2 cm/day (recharge to the sediments) to +14.2 cm/day (discharge to the river), with an average of +1.5 cm/day. These measurements were taken in areas of suspected higher groundwater flux as part of the investigations of upland plume discharges (although not within T4). As such, these values are expected to be higher than the average flux rate for the Portland Harbor Study Area. Measured groundwater flux rates showed substantial variability between measurement sites; in general, the highest seepage rates were observed in sandy areas, and lower values were observed in less permeable silty or clayey zones, as expected. Estimated groundwater fluxes in the T4 SDU are +0.5 cm/day based on an analysis of measured and calculated seepage rates in the Portland Harbor Study Area and T4-specific near-surface sediment grain size distributions (see Section 3.2.4.3 of Appendix Ha of the draft *Feasibility Study* [Anchor QEA 2012] for the analysis methods).

The estimated discharge rates using this existing dataset with reasonable uncertainty bounds can be used for preliminary contaminant transport modeling to evaluate the effectiveness of caps and treatment layers at T4 as part of the Preliminary (30%) RD Report. The BODR will provide a preliminary cap effectiveness evaluation and assess the type and timing of additional data needs, including collection of site-specific porewater and seepage measurements to support cap effectiveness evaluations.

3.3 Sedimentary Processes

T4 has unique sedimentary processes because it consists of off-channel waterways with site-specific vessel traffic patterns. This section discusses hydrodynamic conditions, sedimentation rates, and sediment stability at T4.

3.3.1 Hydrodynamic Conditions

River currents are attenuated in the quiescent off-channel waterways at T4, encouraging sedimentation and potentially promoting natural recovery, which will be verified through additional characterization and analysis. Ambient currents are weak, especially in the interior of the slips, as evidenced by acoustic Doppler current meter (ADCM) measurements collected during the T4 EE/CA (BBL 2005, Appendix G, Attachment 1). At the time of the ADCM survey in March 2004, stronger currents were observed in the mainstem of the Willamette River (averaging 0.5 foot per second and peaking at 1.5 feet per second), with an abrupt transition to weak or negligible currents in the T4 slips, approaching the measurement resolution of the current meter. The survey also showed evidence of a clockwise eddy circulation in Wheeler Bay and weaker eddies in the two slips. These circulation patterns will tend to induce suspended sediments to settle out of the river mainstem and deposit within the terminal area. For this reason, maintenance dredging must be regularly performed at Berth 410, which is rapidly infilled with sediment from the mainstem of the river.

The normally quiescent environment in Slip 3 is periodically interrupted by short-lived propwash events during vessel berthing activities at Berths 410 and 411, during which time bottom velocities of 0.3 to 1.6 feet per second have been observed (BBL 2004). Propwash effects in Slip 1 and Wheeler Bay are negligible due to a lack of current vessel activity. As discussed in Section 3.1.2, if there is future navigation use in Slip 1, it will be limited to shallow-draft barges, which is expected to result in some level of propwash effects. In propwash-affected areas, the use of caps or other in-place remedial technologies will need to consider appropriate engineering controls to prevent cap erosion. The need for a detailed propwash analysis to be conducted for Slips 1 and 3 to inform the cap designs in these areas will be evaluated in the BODR. More quantitative propwash analysis and development of cap armor specifications will be performed to support RD.

3.3.2 Sedimentation Rates

Fine-grained sediments tend to accumulate in quiescent areas. Most of the surface sediments at T4 have 40% to 80% or greater fines content (Figure 3-2; from USEPA FS Figure 2.2-1). The median grain size at T4 is less than 50 microns (Anchor QEA 2012, Appendix La). Although they have slower settling rates, fine-grained sediments can become increasingly cohesive over time and with ongoing burial, which may help to resist resuspension from erosive forces (USEPA 2005).

Overall, T4 is net depositional, based on bathymetric changes from 2004 to 2009 and 2009 to 2018 (Figure 3-3). The main areas of mudline deepening during the survey periods are associated with the 2008 T4 Phase I Removal Action, which was primarily focused on Berth 411, and maintenance dredging actions at Berths 401 and 410. The mudline has accreted by approximately 30 cm (1 foot) or more in Slip 1 and Wheeler Bay. Outside of the berthing lanes, similar or higher sedimentation is also observed in the southern half of Slip 3. The observed sedimentation rates are considered very favorable for natural recovery according to the sediment remediation guidance published by the Interstate Technology Regulatory Council (ITRC 2014), though the effectiveness of natural recovery will need to be verified through additional analysis during the BODR and RD. The main exceptions to the overall depositional condition at T4 are the approach lane and berthing areas at Berths 410 and 411, which are subject to vessel propwash.

3.3.3 Sediment Stability

Sediment stability is an important consideration in the selection and design of in-place remedial technologies and monitored natural recovery (see Section 14.2.9, “Design Requirements,” of the ROD [USEPA 2017b]). The majority of T4 sediments are physically and chemically stable, and where needed, additional stability can be engineered. Various potential sediment disturbance mechanisms—including extreme flood events, earthquakes, wind and vessel waves, vessel propwash, and construction activities—have been evaluated at T4. As discussed in this section, such disturbances were found to have limited potential for resuspending contaminated sediments, the primary exception being localized wave-induced erosion in Wheeler Bay (see Section 3.3.3.3). In the active berthing lanes in Slip 3, sediments resuspended by transient propwash forces are expected to be substantially retained within the protected waterways, pending further design-level evaluation.

A more detailed evaluation of potential physical sediment disturbances (e.g., propwash impacts and remedial or maintenance dredging activities) will be discussed in the BODR. Quantitative propwash modeling to support cap and armor design will be performed as part of RD.

3.3.3.1 Extreme Flood Events

T4 slips and embayments provide off-channel protection from river mainstem currents even during extreme flood events. No flood scour was predicted at T4 during a simulation of the 1996 spring flood event (likely a 100-year return period or greater), and some deposition was even predicted in the mouth of Slip 3 (Anchor QEA 2012, Appendix La, Figure 3-3).

3.3.3.2 Earthquakes

Ash Creek (2011) completed a detailed assessment of the seismic environment at T4 during the design of the Slip 1 Confined Disposal Facility, which is no longer being evaluated (Anchor QEA et al. 2011). This analysis included "mega-thrust" earthquakes along the Cascadia Subduction Zone and shallower crustal earthquakes along known or hypothetical faults.

Recent surface sediments, some of which may be contaminated, and the upper layers of underlying native river alluvium may be subject to liquefaction during an earthquake. At T4, contaminants are concentrated on relatively flat waterway floors where there is little or no gravitational driving force to displace them. If caps are placed on the waterway floors, some cap thinning or lateral cap movement may occur during an earthquake; however, deformed or damaged caps can be easily repaired. If caps are placed on steeper terminal side slopes, further evaluation would be conducted to determine whether additional slope stabilization measures (e.g., armoring or toe buttress) would be needed to reduce the risk of slope failure during an earthquake. A more detailed evaluation of the potential effects of earthquakes on proposed remedial technologies will be discussed in the BODR.

3.3.3.3 Wind and Vessel Waves

Erosive forces from waves are concentrated in shallow water depths (i.e., less than 15 feet) (Anchor QEA 2012, Figure 3.4-17). The waterway floors, where most of the contaminated sediments reside, are largely unaffected by these forces; however, an evaluation will be conducted in the BODR to consider how forces from wind and vessel waves impact technology assignments, especially in existing or proposed shallow water areas. The Wheeler Bay shoreline (characterized by shallow, exposed and partially unarmored slopes) is a unique environment at T4 and has some of the highest exposure to wind and vessel waves at T4. The Wheeler Bay shoreline was stabilized during the 2008 Phase I Removal Action using a combination of habitat elements and more localized structural elements (e.g., riprap) and is routinely monitored for evidence of wave erosion, as described in Section 3.1.5. Erosional events have been observed in localized parts of the Wheeler Bay shoreline during high water events and are attributed to waves from vessel traffic as well as direct damage (scraping or gouging) from anchored logs or floating debris. Proposed repairs are currently being evaluated to prevent future erosion or damage of the Wheeler Bay shoreline (Anchor QEA 2018).

3.3.3.4 Vessel Propwash

For brief periods (i.e., typically averaging about 1 hour), increased bottom velocities may be experienced during vessel docking at Berths 410 and 411. Tugs exert their maximum horsepower (usually no more than one-third power) for short bursts (i.e., 0.5 to 2 minutes) during critical vessel maneuvers (Port of Portland 2016; Anchor Environmental et al. 2006, Appendix L). The operational practice at Slip 3 is to turn large vessels sideways in the river and berth them stern first; thus, if the ships engage their power when they exit the berth, propwash forces will be directed toward the back of the slip. Remedial actions that are planned to be implemented in the Slip 3 berthing areas will need to be designed to accommodate propwash forces. Slip 1 and Wheeler Bay are not currently used by vessels. Any future use of Slip 1 will be limited to shallow-draft barges, and some level of propwash is expected in these areas. Detailed propwash analyses will be conducted for Slips 1 and 3 as part of RD to verify the anticipated propwash forces and inform cap and armor designs in these areas.

3.3.3.5 In-Water Construction

The Port has successfully completed numerous in-water construction projects at T4 in compliance with environmental permits and monitoring requirements (Anchor QEA et al. 2009; Hart Crowser 2017). Water quality modeling results and actual water quality monitoring data indicate suspended sediments generated during dredging are retained within the construction zone near the dredge. The 2008 Phase I Removal Action; Berth 410 maintenance dredging actions in 2008, 2013, and 2017; Berth 401 maintenance dredging in 2015; and various fender pile replacement projects have all been performed at T4 without any significant turbidity or water quality issues.

3.4 Source Control Status

The Port has worked with the Oregon Department of Environmental Quality (DEQ) on upland investigations and remedial actions for more than 20 years. On June 27, 2002, the Port entered into a Voluntary Cleanup Program (VCP) Agreement with DEQ to conduct an FS and implement source control measures on a portion of the Slip 3 drainage basin (DEQ No. LQVCNWR-02-11), and on October 7, 2004, a Consent Judgment between DEQ and the Port was filed in the Circuit Court of Oregon for Multnomah County (No. 0410-10234) to execute the remedy elements of DEQ's ROD for this parcel (DEQ 2003). On December 4, 2003, the Port entered into a VCP Agreement with DEQ to conduct an RI/FS and implement source control measures on a portion of the Slip 1 drainage basin (DEQ No. LQVC-NWR-03-18). Various source control evaluations have also been completed since the Port entered these agreements with DEQ (Ash Creek and NewFields 2007; Ash Creek 2011; Hart Crowser 2000, 2002). A recent summary of these activities is provided in the *Terminal 4 Source Control Briefing Paper* (Apex 2018).

3.4.1 Potential Contaminant Sources

As discussed in Section 2.2.1, PAHs and PCBs are the site-specific focused COCs for T4 identified in the ROD (USEPA 2017b, Table 24). Potential sources of these two contaminants, as well as DDx and dioxins/furans, are discussed in Sections 3.4.1.1 through 3.4.1.4.

3.4.1.1 PAHs

The Port has been investigating and remediating PAH contamination at T4 since the early 1990s (Hart Crowser 2000; BBL 2005; Anchor Environmental et al. 2008; Anchor QEA et al. 2009). The PAH contamination was derived from two main sources: offloading of pencil pitch (a solid hydrocarbon product used in the aluminum industry) in Slip 3 and petroleum seepage (including diesel and bunker C type fuels) associated with a former Union Pacific Railroad (UPRR) fuel pipeline along the head and southern peninsula of Slip 3 that once connected a fuel dock on the river to former aboveground storage tanks on the uplands (Figure 3-4). Wheeler Bay is another area within T4 with PAH contamination. Buried PAH contamination in Wheeler Bay may have been associated with hydraulic disposal of dredged material from other parts of the terminal during filling events in 1948 and in 1957 through 1958 (BBL 2005, Appendix A). Pencil pitch unloading at T4 ceased in 1998, and soil and groundwater contamination associated with the former fuel pipeline is being controlled through various source control actions from the 1990s to the present, as described in Section 3.4.2.

3.4.1.2 PCBs

PCBs may be derived from a variety of historical industrial activities and are generally associated with electrical equipment, hydraulic oils, lubricants, and plasticizers. There are no known current sources of PCBs at T4. On April 25, 1989, a spill of PCB-containing fluid occurred at the electrical substation at Berth 411. The spill was contained within the transformer room and an underlying utility tunnel and was cleaned up under USEPA oversight (HAI 1990). Historical locations of electrical transformers and electrical distribution centers, hydraulic oil leaks, machine shops, and other areas of potential concern were investigated during the RI, but no significant PCB contamination was identified in soil or groundwater at levels of concern on the uplands (Ash Creek and NewFields 2007). Buried PCB contamination in Wheeler Bay may have been associated with hydraulic disposal of dredged material from other parts of the terminal during filling events in 1948 and in 1957 through 1958 (BBL 2005, Appendix A).

3.4.1.3 DDx

DDx, consists of DDT and its degradation products DDE and DDD. DDT is a persistent chlorinated pesticide that was used to control agricultural pests and the spread of insect-borne diseases from World War II until it was banned in 1972 (NPIC 1999). There is some historical evidence of pesticide use at T4; however, there is no specific documentation of DDT use (BBL 2005; Ash Creek and NewFields 2007). Pesticides were evidently used to control insect infestation at the grain terminal on the north side of Slip 1, which was operated by various parties from 1920 until 2003. A fumigation plant on the southeast side of Slip 1 was used to treat imported foodstuffs from 1923 to 1955, and the plant was commandeered by U.S. Army Transport Services for delousing soldiers during World War II (BBL 2005, Appendix A). It is unclear what fumigants may have been used, although an Army directive from 1944 specified use of methyl bromide. These and other areas of potential concern were investigated during the RI, but no significant DDx contamination was identified in soil or groundwater at levels of concern on the uplands (Ash Creek and NewFields 2007).

3.4.1.4 Dioxins/Furans

Based on a review of historical site activities (BBL 2005; Ash Creek and NewFields 2007), no significant combustion or incineration sources or chlorinated chemical manufacturing processes have been identified at T4. Thus, there is no reason to believe dioxins/furans are present at levels of concern in site media. As a result, dioxins/furans have not been a focus of upland or in-water investigations.

3.4.2 Upland Source Control Actions

The primary source control pathways of concern at T4 are groundwater, stormwater, and bank erosion. Those sources are currently controlled or are scheduled to be controlled prior to sediment remediation (Apex 2018).

3.4.2.1 Groundwater Controls

T4 groundwater discharges do not require any further monitoring or control measures at Slip 1 and are being monitored and controlled through coordinated upland and in-water actions at Slip 3, as described in this section.

3.4.2.1.1 Slip 1

The RI for the uplands portion of Slip 1 included a groundwater evaluation of 24 monitoring wells analyzed for petroleum hydrocarbons, PAHs, semivolatile organic compounds, volatile organic compounds (VOCs), PCBs, pesticides, and metals (Ash Creek and NewFields 2007). No significant sources of groundwater contamination were identified during RI activities. Although some elevated concentrations of chlorinated VOCs were traced to an off-site upgradient source (Northwest Pipe Company), these contaminants were attenuated below levels of concern at the Slip 1 shoreline. DEQ approved the RI and determined that groundwater had been adequately addressed, and no further sampling of Slip 1 monitoring wells was required. In its 2016 *Portland Harbor Upland Source Control Summary Report* (Upland Source Control Report), DEQ concluded that the groundwater pathway at Slip 1 is a low priority and source control measures would be excluded from further determination documents (DEQ 2016). Pending formal concurrence by DEQ, groundwater discharges at Slip 1 likely do not require further monitoring or control measures.

3.4.2.1.2 Slip 3

Petroleum seeps of light nonaqueous phase liquid (LNAPL) and impacted groundwater originated at Slip 3 from a release from the former UPRR pipeline. LNAPL recovery has been ongoing since it was identified in 1970, and groundwater monitoring has been conducted since the 1990s (Ash Creek et al. 2005). Concentrations of total petroleum hydrocarbons (TPH)-diesel, TPH-residual, and PAHs indicate a stable or decreasing trend over time.

Completed or ongoing LNAPL and groundwater source control actions on the Slip 3 uplands have included the following (DEQ 2010, 2016):

- **1993.** An interim groundwater and NAPL extraction system was installed at the head of Slip 3 and is still in operation.
- **1998.** The abandoned fuel pipeline on the southern peninsula of Slip 3 was drained and removed.
- **2004.** Approximately 4,580 tons of contaminated riverbank soil at the head of Slip 3 was excavated and a reactive cap amended with organoclay was placed over the excavated soil surface to control diesel seepage associated with the former pipeline as part of the Bank Excavation and Backfill Remedial Action (BEBRA) project (BBL et al. 2005).
- **2008.** As part of the T4 Phase I Removal Action, the reactive organoclay cap at the head of Slip 3 was extended from the uplands down the bank and into the water and was protected with armor rock.
- **2008 to present.** The Phase I Removal Action cap continues to be routinely monitored (Anchor QEA 2018), and no sheen or seeps have been observed at the head of Slip 3 since reactive caps were installed on the uplands and in the water.

Annual sampling and reporting is ongoing in accordance with the *LNAPL Removal, Groundwater Monitoring, and Contingency Plan* (Ash Creek et al. 2005), as required by the Slip 3 Uplands ROD (DEQ 2003). In its 2016 Upland Source Control Report, DEQ concluded that the groundwater pathway at Slip 3 is a medium priority, and source control determinations are anticipated in 2020. The ongoing upland groundwater work will be coordinated with any future actions that may be needed to address potential residual sources on the riverbanks of Slip 3 (see Section 3.4.2.3.2). A more thorough presentation of Slip 3 groundwater observations and trends is provided in the *Annual 2018 Groundwater Monitoring and LNAPL Removal Report, Terminal 4 Slip 3 Upland Facility*

(Apex 2019). TPH and PAHs continue to be monitored in Slip 3 groundwater, and an evaluation of the potential for recontamination of the in-water remedy from Slip 3 groundwater will be provided in subsequent design documents.

3.4.2.2 Stormwater Controls

Stormwater discharges from T4 are permitted under the Port's National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit and Kinder Morgan's NPDES 1200-Z General Industrial Stormwater Permit. There are 10 drainage basins at T4: four basins drain to Slip 1 (Basins Q, O, N, and M), one drains to Wheeler Bay (Basin L), two drain to Slip 3 (Basins K and J), and three drain to the Willamette River (Basins S, R, and D) (Figure 3-5). In addition, City of Portland municipal drainage basin 52C drains an off-site area around North Lombard Street and discharges to the head of Slip 1 (City of Portland 2013).

The Port prepared, and DEQ approved, the T4 Storm Water Evaluation Work Plan (Ash Creek and NewFields 2007). Subsequently, the Port submitted a Storm Water Source Control Evaluation (Ash Creek 2009), Storm Water Source Control Completion Report (Ash Creek 2011), *Screening Level Recontamination Analysis for Storm Water Basins L and M at Terminal 4* (Formation Environmental 2012), Additional Storm Water Sampling Work Plan, T4 Slip 1 (Ash Creek 2012), Storm Water Sampling Results, T4 Slip 1 (Ash Creek 2013), *Revised Additional Stormwater Source Control Measure Work Plan Terminal 4 Slip 1 Facility* (Apex 2013), and *Terminal 4 Source Control, Decision Support Data Collection Work Plan* (Geosyntec 2015) and Data Summary Report for Slips 1 and 3 (Geosyntec 2016).

In response to these investigations, a number of stormwater source control measures have been implemented at T4, including the following (Apex 2018):

- Extensive cleaning of accumulated solids in the stormwater conveyance systems at Basins K, L, M, and N was conducted in 2010 and catch basin inserts were installed at several locations.
- A StormFilter vault was installed for end-of-pipe treatment at Basin M in 2006. This treatment vault was improved in 2012 by adjusting the weir to reduce by-pass volumes and replacing the filtration media with zeolite, perlite, and granular activated carbon ("ZPG" media).
- Green infrastructure features were installed along the T4 entrance road in 2013 through 2015, including vegetated swales and an infiltration basin that manages runoff from nearly 3.5 acres, and pervious pavement was placed that eliminates more than an acre of impervious surface.
- The Port continues to work with its tenants to implement general stormwater best management practices, including ongoing monitoring, upline source tracing, pavement sweeping, and cleanout of stormwater inlets.

T4 stormwater investigations have indicated that additional source control measures are warranted in Basins K, L, and M, primarily to control PAH and total suspended solids loads. The Port is currently supporting stormwater treatability studies, flow monitoring, and infiltration testing to support the selection and design of additional source control measures in these basins. In addition, the Port's tenant, Kinder Morgan, continues to move forward on corrective actions associated with its NPDES permit. The control of the stormwater pathway at T4 is considered "in progress" according to DEQ. The Port plans to include an evaluation of the potential for recontamination of the in-water remedy from the stormwater pathway in subsequent design documents.

3.4.2.3 Bank Erosion Controls

Riverbanks at T4 have been surveyed to identify areas of potentially erodible soil that could, if contaminated, impact adjacent waterway sediments. These areas were characterized through sampling and analysis programs under DEQ oversight in the Slip 1/Wheeler Bay area (Ash Creek and NewFields 2007) and Slip 3 area (Ash Creek 2009). Select maps and tables of riverbank characterization data are compiled in Appendix C and discussed in this section. Bank stabilization and removal actions have already been completed in some of these areas. The remaining riverbank data that have not yet been addressed will be screened against sediment cleanup levels, RALs, and PTW thresholds in the BODR to determine if or what additional bank stabilization or remediation measures may be needed.

3.4.2.3.1 Slip 1 and Wheeler Bay

The following two areas of potentially erodible soil were identified in this part of T4, one on the southwest bank of Slip 1 and the other on the north and east banks of Wheeler Bay. Riverbank samples from these areas were analyzed for TPH, PAH, metals, chlorinated pesticides, PCBs, and phthalates (Ash Creek and NewFields 2007; Apex 2018).

- **Southwest Bank of Slip 1.** Analytical results from the southwest bank of Slip 1 are well below Portland Harbor RALs and are, therefore, considered a low priority (Apex 2018). PCBs were undetected, and DDx and PAHs are one to two orders of magnitude below the RALs. Therefore, no source control measures are proposed in this area.
- **Wheeler Bay.** Analytical results from the north and east banks of Wheeler Bay were detected at levels of concern that could potentially impact adjacent sediments (Apex 2018). Therefore, this area was stabilized with bioengineered features and riprap as part of the 2008 T4 Phase 1 Removal Action (Anchor QEA et al. 2009). The stabilized Wheeler Bay shoreline is largely functioning as intended; however, minor areas of erosion have been observed in the willow planting area above +15 feet National Geodetic Vertical Datum following extreme high-water events. A conceptual approach for repairing the Wheeler Bay bank has been proposed, which consists of expanding the armor rock coverage to higher elevations and potentially modifying some of bioengineered features (Anchor QEA 2018).

3.4.2.3.2 Slip 3

Three areas of potentially erodible soil were identified in this part of T4, one on the northeast corner of Slip 3, one along the south bank of Slip 3, and a third along the Willamette River north of the Berth 414 area. In consideration of the known site sources (i.e., pencil pitch handling and fuel leaks/spills), riverbank samples from these areas were analyzed for PAHs (Ash Creek 2009; Apex 2018).

- **Northeast Corner of Slip 3 (Slip Bank).** In October 2009, this area was controlled through soil remediation. The remedial action consisted of excavating high-concentration soil to a depth of 4 feet, backfilling to original grade with clean import material; placing a gravel cover for erosion protection on the riverbank; and placing topsoil, plant, and mulch on the uplands (Apex 2018). This action is compatible with the adjacent BEBRA work at the head of Slip 3, which included grading, stabilizing, and landscaping of the adjacent bank to the south of the removal area and placing 12 inches of topsoil and plantings in accordance with the City of Portland's Greenway requirements.
- **South Bank of Slip 3.** Based on an evaluation of existing riverbank characterization data, additional source control measures consisting of limited soil removal and bank stabilization are recommended in this area. These measures are planned to be implemented concurrent with the adjacent in-water remedy (Port of Portland 2009; DEQ 2016) and will be further evaluated in the BODR.
- **Willamette River Bank (North of Berth 414).** During bank improvement work in 2003, pencil pitch was observed in a small area along this bank. Under DEQ oversight, a small (approximately 50 cubic yards [cy]) removal action was conducted followed by bank stabilization; however, pencil pitch was still observed in the area following the removal action. Additional source control measures consisting of limited soil removal and bank stabilization are recommended in this area. These measures are planned to be implemented concurrent with the adjacent in-water remedy (Port of Portland 2009; DEQ 2016) and will be further evaluated in the BODR.

A compilation of existing analytical data from these bank areas is provided in Appendix C. An initial review of the data indicates multiple bank soil samples on the south bank of Slip 3 and the Willamette River bank exceed both the current and proposed RALs for total PAHs. The Port plans to include a more detailed screening of riverbank data against cleanup levels, RALs, and PTW thresholds and an evaluation of the potential for recontamination of the in-water remedy from bank erosion in subsequent design documents.

3.4.3 Previous Sediment Remedial Actions

Previous upland and in-water remedial actions completed at T4 are shown in Figure 3-4. In the water, the Port has implemented a number of sediment remediation and removal actions over the last few decades, primarily in Slip 3, to reduce ongoing site risk from contaminated sediments. Foremost among them was the T4 Phase I Removal Action in 2008 (Anchor QEA et al. 2009). The Port has also conducted navigational dredging projects that simultaneously resulted in the removal of contaminated sediments. The chronology of sediment remediation and removal actions at T4 includes the following:

- **1984.** The Port dredged approximately 5,000 cy of material that had accumulated in the pencil pitch unloading berths (Port of Portland 1992).
- **1993 to 1995.** In 1993, the Port entered into a Consent Decree with the United States (Port of Portland et al. 1993), and in 1995, the Port removed 35,000 cy of contaminated sediment from Slip 3 (Port of Portland 1995a, 1995b).
- **1997.** The Port removed 5,400 cy of sediment from around the pencil pitch unloading berths as part of a maintenance dredging action (Port of Portland 1998a, 1998b).
- **1998.** Hall-Buck (now Kinder Morgan) undertook dredging in Slip 3 to remove pencil pitch spilled on June 18, 1997. In this year, pencil pitch loading at T4 was discontinued (Hartman Consulting Corporation 1998).
- **2002 to 2005.** The Port removed approximately 4,750 cy of contaminated sediment from Berths 410 and 411 during maintenance dredging projects. In addition, 2,700 cy of contaminated sediment below the ordinary high water mark was removed as part of the BEBRA project (BBL et al. 2005).
- **2008 Removal Action.** The T4 Phase I Removal Action was performed under an Administrative Order on Consent with USEPA (USEPA 2003, 2006). Approximately 12,800 cy of contaminated sediment was removed from Slip 3; a reactive cap (amended with organoclay), sand cap, and sand cover were placed at the head of the slip; and the Wheeler Bay shoreline was stabilized by flattening the slope, armoring, and planting to eliminate sloughing and erosion. The contaminant reductions resulting from the Phase I Removal Action work are shown in Figure 3-6, which compares the sediment quality conditions in Slip 3 before and after the Phase I Removal Action was performed.
- **2013 to 2017.** The Port removed approximately 5,500 cy of material in 2013, and another 6,744 cy of material in 2017 during maintenance dredging actions at Berth 410 (Hart Crowser 2012, 2017; PSET 2012).

3.5 Risk Exposure Pathways

In the Portland Harbor ROD, remedial action objectives (RAOs) were developed to provide media and pathway-specific goals for protecting human health and the environment. The ROD remedy, which focuses on addressing sediment RAOs through sediment remediation, is expected to aid in achieving surface water RAOs as well. RAOs associated with contaminated sediments and their corresponding risk drivers at T4 are as follows:

- **Human Health Direct Contact (RAO 1).** This RAO aims to reduce cancer and noncancer risks to people from incidental ingestion of and dermal contact with COCs in sediments and beaches to acceptable levels. The PAH ROD SMA at T4 is largely associated with human health direct contact risks to fishers from exposure to cPAHs. This RAO is already met for PCBs under current conditions (i.e., current PCB surface-weighted average concentrations [SWACs] are less than the RAO 1 risk-based goal of 370 μg/kg). The PCB SWAC for the RM 4.5E SDU is 80 μg/kg (ROD Appendix IV Table J2.3-7). The maximum SWAC on a 0.5-RM scale (the spatial scale evaluated for direct contact in the Baseline Human Health Risk Assessment) for segments between RMs 4 and 5 is 307 μg/kg at RM 4 E (ROD Appendix IV Table J2.2-1b).
- **Human Health Fish/Shellfish Consumption (RAO 2).** This RAO aims to reduce cancer and noncancer risks to acceptable levels for human consumers of fish and shellfish in which COCs have bioaccumulated. The majority of fish consumption risk at T4 is largely associated with PCBs. This RAO is already met for PAHs based on the clam consumption cleanup levels presented in the ROD. However, USEPA is further evaluating the PAH cleanup levels as part of the recent revisions to cPAH toxicity (USEPA 2017c) and the potential impacts of these revisions to Portland Harbor.
- **Ecological Benthic Direct Contact (RAO 5).** This RAO aims to reduce risk to benthic organisms from ingestion of and direct contact with COCs in sediment. Past remedial actions at T4, including the 2008 Phase I Removal Action, have been mainly focused on reducing direct contact risk to benthic organisms from PAHs and petroleum. In Slip 3 and Wheeler Bay, the area of potential risk to benthic organisms overlaps with the area of potential human health direct contact risk because both are associated with high concentrations of PAHs.
- **Ecological Prey Consumption (RAO 6).** This RAO aims to reduce risk to ecological receptors that consume COCs in prey. The PCB risk-based goal for RAO 6 is based on prey consumption risk for mink potentially exposed to PCBs in surface sediments and is greater (i.e., less restrictive) than the PCB RAO 2 goal for human health fish consumption risk. Therefore, RAO 6 is not driving sediment remediation at T4. In general, PAHs do not pose a significant bioaccumulation risk to wildlife, and cleanup levels were not developed in the FS.
- **Riverbank (RAO 9).** This RAO aims to reduce migration of COCs in erodible riverbank soils to sediments and surface water, which will reduce the risk of site recontamination. Because there are no publicly accessible beaches at T4, risk-based goals for RAO 9 are those required to protect human health and ecological receptors in adjacent waterway sediments.

3.6 Data Gaps for Conceptual Site Model Refinement

At this time, no data gaps have been identified to refine the Port's CSM for T4. It is anticipated that additional CSM-specific data (e.g., geotechnical data to inform the design of in-place technologies and dredging to protect terminal structures and side-slopes) would be collected in a subsequent investigation. Once preliminary SMAs have been delineated and preliminary technology assignments have been made, such data can be collected much more efficiently and cost effectively.

4 Selection of Remedial Technologies

Remedial technologies will be selected for T4 during the Preliminary (30%) RD in accordance with the ROD as discussed in Section 4.1. Whereas technology assignments presented in ROD Figures 31a through 31e were based on more general FS-level criteria and applied to the entire harbor, the Preliminary (30%) RD will incorporate site-specific design limitations and considerations (presented in Section 4.2) to refine selected technologies to ensure that they are constructible, environmentally protective, and cost-effective.

4.1 Record of Decision Flexibility on Remedial Technology Approach

The overall remedial technology approach for Portland Harbor is described in the ROD Section 14.2.9, "Design Requirements," and Figure 28, TADT (reproduced as Figure 1-3). T4 contains FMD areas, intermediate areas (which have limited or no future navigation requirements), and very limited shallow areas (above -2 feet CRD), primarily in Wheeler Bay (Figure 4-1).

4.1.1 Current and Future Navigation Considerations

In potential FMD areas, the ROD requires dredging or dredging and capping with the top elevation of caps placed below the navigation depth along with an additional buffer to protect the cap from FMD actions. The ROD assumed that all of Slips 1 and 3 were potential FMD areas. As discussed in Section 3.1.2, Slip 1 has no existing water-dependent uses but may be developed for shallow-draft barge use in the future, and the southern portion of Slip 3 (adjacent to former Pier 5) does not have any current or planned future uses. As the Port has discussed with USEPA, such considerations would impact selection of feasible remedial technologies for T4, including evaluation of capping in locations no longer needed for deep-water navigation. Section 14.2 of the ROD specifically allows for "eliminating the need for a more expensive dredge and armored cap remedy if a significant area will no longer to be used for marine terminal purposes." USEPA has agreed that a site-specific application of this ROD flexibility, in accordance with ROD Section 14.2.9, will resolve "whether capping is an available technology where it can be shown to be compatible with current and future navigation needs at Terminal 4" (USEPA 2018b).

4.1.2 Matching Pre-Construction Mudline Elevations

Remediation of shallow areas incurs additional requirements, specifically that the pre-construction mudline elevation must be reestablished using clean backfill material, if necessary, and a habitat layer such as beach mix is placed for the final cover. However, since issuance of the ROD, the Port and USEPA have discussed this issue further with respect to T4 and determined that "USEPA [will] provide the Port the opportunity to evaluate designing post-remedy surfaces at shallower depths considering the requirements described in the ROD at Section 14.2.9 *Design Requirements*" (USEPA 2018b).

4.1.3 Remediation of Principal Threat Waste

In areas with highly toxic PTW, the ROD states that "cap design may require the use of activated carbon and/or other reactive material, as necessary, to meet RAOs" (USEPA 2017b, Section 14.2.9.1, p. 113). There is one isolated PTW area in the T4 SDU (in Slip 1) that is based on one surface sediment sample with a total PCB concentration of 1,000 µg/kg, which exceeds the highly toxic PTW threshold of 200 µg/kg (Figure 2-2). An apparent PCB PTW area is also shown on the northern boundary of the SDU on the downstream end of Berth 401 (Figure 2-2). However, this apparent PTW occurrence is based on a data extrapolation artifact from the adjacent downriver site. No existing sediment data at Berth 401 exceed the PTW threshold. Aside from the one isolated occurrence of highly toxic PTW in Slip 1, there is no confirmed PTW associated with source material (i.e., NAPL) or PTW that cannot be reliably contained within the T4 SDU.

4.1.4 Other Site-Specific Considerations for Remedial Technology Selection

Outside of potential FMD areas in intermediate water depths, the use of dredging or capping is dependent on site-specific design analysis in consideration of structures, debris, slopes, marine terminal operations, and other factors (USEPA 2017b, Section 14.2.9.1; Figure 1-3), all of which are important considerations at T4. Specifically, it is presumed that dredging is not likely feasible in many parts of T4 because of the risk of undermining steep riprapped terminal slopes, in-water and over-water terminal structures, and engineered caps and stabilized shorelines that were previously placed during the 2008 T4 Phase 1 Removal Action. The potential site-specific limitations (e.g., structural and slope stability concerns associated with dredging) will be evaluated in the BODR and RD.

4.2 Preliminary Delineation of Dredging and Capping Areas

During the Preliminary (30%) RD, a range of remedial technologies will be evaluated, including in-place technologies such as engineered caps, reactive caps, thin-layer caps, and thin-layer reactive caps (i.e., in situ treatment), in addition to dredging. The range of dredging and capping options the Port plans to evaluate in preliminary design will be developed based on site-specific navigation requirements, structural constraints, and slope stability concerns discussed in Section 4.1. The range of dredging and capping options is shown in Figure 4-2 and is consistent with previous communications with USEPA (USEPA 2018b).

The Port proposes to implement a balanced application of remedial technologies that would be appropriately tiered to effectively address site risks, while accommodating site-specific navigation requirements, structural constraints, and slope stability concerns. The navigational needs at the T4 SDU require additional consideration. For example, the future water-dependent uses at Slip 1 will be limited to shallow-draft barge use, compared to the ROD assumption that Slip 1 will serve deep-draft ocean-going vessels. This water-dependent use change provides expanded opportunities to apply in-place technologies in Slip 1. The BODR and 30% RD will consider future site operations during remedial technology assignment evaluations.

As stated in Section 4.1.4, dredging is not likely feasible in many parts of T4 because of the risk of undermining steep riprapped side slopes at the terminal, terminal structures, and remediation features that were previously installed during the 2008 T4 Phase I Removal Action (e.g., organoclay treatment cap at the head of Slip 3 and stabilized shoreline in Wheeler Bay). Geotechnical investigations and structural surveys will be performed as part of a future design investigation to further define site constraints and design limitations.

T4 provides opportunities to apply containment and/or in situ treatment remedial technologies. Several lines of evidence show that stable sediment conditions are present throughout much of the T4 SDU (see Section 3.3.3), which supports the use of protective in-place remedial technologies. Berths 410 and 411 will need to be maintained to serve deep-draft ocean vessels. However, if dredging poses a risk to existing slopes or structures, thin-layer technologies (for example, in situ treatment with activated carbon) may warrant evaluation. In situ treatment layers can provide very effective contaminant sequestration properties while causing minimal impact to navigation, habitat, and flood rise.

The evaluation of potential in situ remedial technologies for the T4 SDU, such as capping and amended capping (i.e., in situ treatment), will be detailed in the BODR and Preliminary (30%) RD and supported with technical evaluations including scour analysis and contaminant transport modeling.

4.3 Data Gaps for Technology Selection and Preliminary (30%) Design

At this time, no data gaps have been identified that would hinder preliminary remedial technology selection and development of the Preliminary (30%) RD for T4. It is anticipated that additional technology-specific data (e.g., geotechnical data to support structural and slope stability analyses) would be collected in a design-phase investigation subsequent to the Preliminary (30%) RD. Once preliminary SMAs have been delineated (data gaps identified for SMA delineation are discussed in Section 2.3) and preliminary technology assignments have been made, such data can be collected more efficiently and cost effectively.

5 Pre-Remedial Design Investigation

As outlined previously, data gaps have been identified for SMA delineation but not for technology assignment or preliminary (30%) RD. As such, the focus of the PDI for the T4 SDU will be the collection of additional sediment data to fill data gaps associated with SMA delineation, consistent with the ROD. PDI sampling of surface and subsurface sediment is proposed at the locations shown in Figures 5-1 and 5-2, respectively, to address the data gaps identified in Section 2.3. The combined surface and subsurface sampling proposal is shown in Figure 5-3.

A summary of the sampling program and objectives is described in this section. Details regarding the sampling locations, methods, sample analytes, and quality assurance/quality control protocols are presented in the *Sampling Quality Assurance Project Plan* (SQAPP; Appendix A).

5.1 Pre-RD Group Data

As described in Section 1, the Pre-RD Group completed a new bathymetric survey and surface and subsurface sediment sampling and analysis in 2018 in accordance with the Pre-RD Group Work Plan (Geosyntec 2017). The purpose of the Pre-RD Group sampling activities was to refine the delineation of SMAs in Portland Harbor, inform technology assignments consistent with the TADT (Figure 28 in the ROD), and refine the horizontal and vertical extent of dredging and capping areas. The Pre-RD Work Plan also addresses many sampling objectives required for long-term monitoring.

Some of the 2018 Pre-RD Group sampling activities occurred within the T4 SDU, including the sediment sampling locations shown in Figures 5-1 and 5-2. To avoid redundancy, the coverage of Pre-RD Group samples both within and outside of the existing T4 ROD SMAs were considered in the development of the PDI sampling proposal for T4. Pre-RD Group samples were analyzed for harbor-wide focused COCs in the ROD (including PAHs, PCBs, DDx, and dioxins/furans). Pre-RD Group data collection is currently ongoing. The final results of the Pre-RD Group investigations were not available at the time this PDI Work Plan was developed; however, Pre-RD Group data will be used to supplement T4 data during the RD as those data become available. The Port plans to incorporate the Pre-RD Group T4 data as part of a PDI Summary Report, as appropriate.

5.2 Surface Sediment Investigation

Surface sediment sampling is proposed throughout the ROD SMA and in adjacent underpier areas to replace existing surface sediment data that are outdated and may no longer be representative of current conditions (i.e., due to deposition during the past 10 to 20 years) and to address locations where the lateral extent of contamination by T4 focused COCs (PAHs and PCBs) may require further refinement.

The surface sediment program will consist of 64 surface grab samples, including 10 diver grabs in underpier areas (access permitting), collected on a grid of approximately 150-foot centers throughout the T4 ROD SMA, excluding locations already collected by the Pre-RD Group (Figure 5-1). Surface grab samples will be three-point composites from 0 to 30 cm (0 to 1 foot) below the mudline.

All surface sediment samples will be analyzed for PAHs, PCB congeners, grain size, total solids, and total organic carbon. Because dioxins/furans do not exceed the RAL in any surface samples and are not a focused COC for T4, approximately 25% of surface samples will be analyzed for dioxins/furans to improve data density for dioxins/furans within the T4 SDU and to verify their lack of significance at T4 or otherwise aid in SMA delineation. Material from every surface sample location will be archived in case additional delineation of dioxins/furans (or reanalysis of any other COCs) is needed based on the initial results. There were no exceedances of the DDx RAL in surface sediment in the T4 SDU; as such, surface sediment DDx data do not represent a data gap for SMA delineation, and collection of additional DDx data in surface sediments is not warranted. Additional details regarding sampling methods and analyses are included in the SQAPP (Appendix A).

5.3 Subsurface Sediment Investigation

Subsurface sediment sampling is proposed within the ROD SMA to address locations where the vertical extent of contamination by T4 focused COCs is not fully defined. The subsurface sediment program will consist of 17 standard sediment cores, which will be collected with a vibracore, and 10 underpier sediment cores, which will be collected with the assistance of a diver. The standard subsurface cores will include six cores in the PCB PTW area in Slip 1 (one co-located with the previous sample location) to verify the extent of PCB PTW; four cores in the southeast corner of Wheeler Bay (one co-located with a previously unbounded core location) to bound the vertical extent of PAHs and verify the vertical extent of PCBs; one core in western Wheeler Bay (near the navigation channel) to investigate the vertical extent of PCBs; four cores at the head of Slip 3 to verify the vertical extent of PAH, PCB, and DDx contamination; one core in the Berth 401 area to verify the vertical extent of PCBs; and one core upstream of Slip 3 (co-located with a previous unbounded location) to verify the vertical extent of DDx contamination (Figure 5-2). The underpier cores will be co-located with the 10 underpier surface grab samples (Figure 5-2) to characterize subsurface sediments in these areas.

Standard sediment core samples will be co-located with surface sediment grab samples (either proposed in this PDI or previously collected by the Pre-RD Group) and will be sampled in 2-foot increments from 1 to 15 feet below the mudline (i.e., at 1 to 3 feet, 3 to 5 feet, 5 to 7 feet, etc.). Sampling in 2-foot increments is consistent with the approach used in most of the historical sampling events at T4, including those supporting the EE/CA and Phase 1 Removal Action. Additional data may be collected in areas designated for dredging during a subsequent design-phase investigation if better vertical resolution is needed. Underpier cores (diver-collected) will be advanced to the maximum depth practicable (typically no greater than 3 feet below mudline) and sampled in 1-foot intervals, as practicable based on recovery.

Core samples will be selectively analyzed to address specific data gaps as follows:

- **Berth 401.** A total PCB PTW area is shown on the northern (downstream) boundary of Berth 401 (Figure 5-1). This apparent PTW area is based on a data extrapolation artifact from the adjacent downriver site. No existing surface sediment data at Berth 401 exceeds the PTW threshold. The Pre-RD group collected two surface sediment samples in this area, and two additional post-dredge samples are available from a recent Berth 401 maintenance dredging event. Though existing data are below the PCB PTW threshold, additional surface and subsurface sediment sampling is proposed to verify the extent of potential PCB contamination at Berth 401. A sample from the 1- to 3-foot depth interval will be analyzed for PCB Aroclors.
- **Slip 1.** The PTW area in Slip 1 is based on an exceedance of the PCB PTW threshold in the top foot (0 to 30 cm [0 to 1 foot]) of location VC-13. As shown in Figure 5-2, six surface sediment samples are proposed to be co-located with and surrounding VC-13. Because of ongoing deposition at T4 since VC-13 was collected, it is possible that this concentration is now buried. Alternatively, it may have been a laboratory artifact because it was not corroborated by any other results from this or adjacent cores. Therefore, one core will be co-located with the previous core location VC-13 to verify the presence and extent of PCB PTW in this area. Samples from the 1- to 3-foot and 3- to 5-foot depth intervals will be analyzed for PCB Aroclors. All other deeper sample intervals will be archived for potential follow-up analysis, if needed. The other five proposed cores in Slip 1 surrounding the existing PTW exceedance will be collected and archived for potential follow-up analysis, as needed, following review of the proposed co-located surface sediment analytical results at each of these locations.
- **Wheeler Bay.** Similar to what was collected by the Pre-RD Group, one core will be co-located with previous core location HC-S-42 (as practicable based on water depth and access) to verify the extent of PAHs and PCBs in this area (i.e., below 4 feet). Samples will also be collected from three additional cores in Wheeler Bay that surround the reoccupied station. In these three surrounding cores, samples from the 1- to 3-foot, 3- to 5-foot, and 5- to 7-foot depth intervals will be analyzed for PAHs and PCB Aroclors. In the core that reoccupies previous core location HC-S-42, all core sample intervals will be archived for potential analysis based on a review of Pre-RD data collected at this station. As discussed in Section 2.3, because the PCB RAL exceedances at Wheeler Bay locations VC-20 and VC-21 are covered by 3 to 5 feet of sediment that is below the RAL, these locations do not represent a data gap for SMA delineation. However, areas of buried contamination (such as these examples) will be further evaluated as part of the BODR in consideration of their physical and chemical stability.

In addition, a core will be collected adjacent to the navigation channel in Wheeler Bay to better understand the nature and extent of PCB impacts within the ROD SMA.

- **Slip 3.** Four cores will be collected surrounding Stations B41106 and HC-S-07 at the head of Slip 3. Based on existing PAH and PCB exceedances in the top 3 feet at these locations, combined with additional subsurface exceedances in the 8- to 9-foot and 9- to 10-foot depth intervals at B41106, proposed core samples from the 1- to 3-foot, 3- to 5-foot, 5- to 7-foot, 7- to 9-foot, 9- to 11-foot, and 11- to 13-foot depth intervals will be analyzed for PAHs and PCBs. The 13- to 15-foot sample interval will be archived from each core for potential follow-up analysis, if needed. Based on an existing DDx exceedance at nearby station VC-29, samples from the two proposed cores closest to this historical station will also include DDx analysis in the 1- to 3-foot and 3- to 5- foot depth intervals. The DDx exceedance at Station VC-29 (in the 1- to 3-foot depth interval) is bounded by multiple deeper intervals that are below the RAL; however, additional DDx testing is proposed in this area.
- **Upstream of Slip 3.** One core will be co-located with previous core location PI-09 to verify the vertical extent of DDx in this area. At PI-09, which is outside the ROD SMA, a historical DDx RAL exceedance is shallow (i.e., from 1- to 2-feet below mudline) and unbounded at depth. As such, a core has been proposed near PI-09 to verify the occurrence and depth of DDx impacts in this area. Based on the existing DDx exceedance, proposed core samples from the 1- to 3-foot and 3- to 5-foot depth intervals will be analyzed for DDx. All other core sample intervals will be archived for potential follow-up analysis, if needed.
- **Underpier Areas.** Ten co-located underpier subsurface sediment cores are proposed to characterize subsurface sediment COC concentrations in portions of the Pier 2 area of Slip 1 and Berth 411 area of Slip 3 where surface sediment samples are also proposed (Figure 5-2). Underpier cores will be collected with the assistance of a diver and will target the maximum depth practicable in these areas (i.e., based on access, the depth of soft sediment that has accumulated on these riprap slopes, and equipment limitations). Underpier samples will be archived in 1-foot increments, to the extent practicable (e.g., based on recovery), for potential analysis based on the results of underpier surface sediment results and discussions with USEPA. All core sample intervals submitted for chemical analysis will also be tested for conventional parameters, including grain size, total solids, and total organic carbon, sample volume permitting.

5.4 Contingency Analyses

Contingency analysis of archived sediment samples will be selected in consultation with USEPA and may include the following:

- Reanalysis to verify an unusual exceedance (e.g., to verify a new RAL or PTW exceedance in an area not formerly suspected to contain elevated concentrations)

- Reanalysis to achieve better reporting and detection limits (e.g., if a sample is non-detect with an elevated detection or reporting limit)
- Analysis of archived samples based on the results of initial sampling, such as the following:
  - Analysis of additional COCs such as dioxin/furans and DDx
  - Analysis of deeper subsurface core intervals to bound the vertical extent of contamination with one or more sample intervals below RALs
  - Analysis of archived discrete surface sediment samples that were used to form a composite sample to better constrain the source and extent of a RAL exceedance in the composite, if appropriate
- Analysis of archived samples based on the results of the Pre-RD Group's sampling efforts
- Analysis of archived samples for reanalysis of PCBs if the results for PCBs by USEPA Method 8082A are unable to achieve the 9-µg/kg reporting limit

Preliminary analytical data for surface and subsurface samples will be reviewed prior to identifying potential contingency analyses. The Port will evaluate preliminary data and provide a recommended approach to USEPA for additional testing. Following approval by USEPA, the Port will proceed with the selected contingency analyses.

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Tables

Figures

Appendix A
Sampling Quality Assurance Project Plan

Appendix B
Health and Safety Plan

Appendix C
Supporting Upland/Source Control Documentation

Tables

Table 2-1

Remedial Action Levels and Principal Threat Waste Thresholds

Focused COCs			
PCBs	75	200	1,000
Total PAHs	13,000	NA	170,000
2,3,7,8-TCDD	0.0006	0.01	0.002
1,2,3,7,8-PeCDD	0.0008	0.01	0.003
2,3,4,7,8-PeCDF	0.2	0.2	1
DDx	160	7,050	650
Additional Contaminants			
2,3,7,8-TCDF	NA	0.6	NA
1,2,3,4,7,8-HxCDF[4]	NA	0.04	NA
cPAHs (BaP Eq)	NA	106,000	NA
Chlorobenzene	NA	>320	NA
Naphthalene	NA	>140,000	NA

Notes:

1. Table reproduced from Table 21 of the Portland Harbor Record of Decision (USEPA 2017). All values are in µg/kg.
2. Site-wide includes all areas of the site except the navigation channel. FMD areas are subject to these RALs. Site-wide RALs are for Alternative F Modified.
3. PTW thresholds are based on highly toxic PTW values (10^{-3} risk) except chlorobenzene and naphthalene, which are threshold values for not reliably contained PTW.
4. Listed in ROD Table 21 (in error) as "1,2,3,4,6,7,8-HxCDF."

µg/kg: micrograms per kilogram
BaP Eq: benzo(a)pyrene equivalent
COC: contaminant of concern
cPAH: carcinogenic polycyclic aromatic hydrocarbon
DDx: dichlorodiphenyldichloroethane + dichlorodiphenyldichloroethene + dichlorodiphenyltrichloroethane
FMD: future maintenance dredge
HxCDF: hexachlorodibenzofuran
NA: not applicable
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PeCDD: pentachlorodibenzo-p-dioxin
PeCDF: pentachlorodibenzofuran
PTW: principal threat waste
RAL: Alternative F Modified remedial action level
ROD: Record of Decision
TCDD: tetrachlorodibenzo-p-dioxin
TCDF: tetrachlorodibenzofuran

Table 2-2
Terminal 4 Sediment Data Sources

Data Collection Event	Reference	Dates of Collection		No. of Sample Locations
Surface Sediment Data in USEPA FS Database				
Portland Harbor Sediment Investigation	Weston 1998	9/18/1997	10/17/1997	10
Port of Portland Terminal 4 Remedial Investigation	Hart Crowser 2000	10/12/1998	10/15/1998	23
City outfall sediment investigations	CH2M Hill 2004	10/15/2002	10/15/2002	5
Round 1 co-located surface sediment	Integral 2004	10/24/2002	10/24/2002	1
Terminal 4 Early Action EE/CA Report	BBL 2005	3/3/2004	4/21/2004	42
Round 2a beach sediment composites	Integral 2005	7/28/2004	7/28/2004	3
Round 2a sediment grabs	Integral 2005	8/13/2004	8/13/2004	1
2005 Portland District O&M Dredge Sediment Characterization	Tetra Tech 2006	5/26/2005	5/26/2005	3
Round 2b benthic sediment	Integral and Windward 2006	12/14/2005	12/16/2005	4
Terminal 4 Anchor Appendix G Sediment Data	Anchor Environmental 2008	7/19/2006	12/13/2007	9
Terminal 4 Abatement Phase 1 – Construction Phase 1 – Dredging and Capping	Anchor QEA 2009c	12/29/2008	12/30/2008	17
Subsurface Sediment Data in USEPA FS Database				
Portland Harbor Sediment Investigation	Weston 1998	9/18/1997	10/17/1997	2
Port of Portland Terminal 4 Remedial Investigation	Hart Crowser 2000	10/12/1998	10/15/1998	8
Terminal 4 Early Action EE/CA Report	BBL 2005	3/3/2004	4/14/2004	42
Terminal 4 Anchor Appendix G Sediment Data	Anchor Environmental 2008	7/18/2006	12/13/2007	12
Sediment Data Evaluated but not in USEPA FS Database				
Berth 401 Maintenance Dredging: Post-Dredge Surface Results	Hart Crowser 2015	8/11/2015	8/11/2015	2
Berth 410 Maintenance Dredging Sediment Characterization (Subsurface)	Hart Crowser 2017	11/15/2016	11/15/2016	3
Berth 410 Maintenance Dredging: Post-Dredge Surface Results	Hart Crowser 2018	11/6/2017	11/6/2017	3

Notes:
EE/CA: Engineering Evaluation and Cost Analysis
FS: Feasibility Study
O&M: operation and maintenance
USEPA: U.S. Environmental Protection Agency

Table 2-3
Summary of Existing Surface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total PCB Congener (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**								
Berth 401 Post-Maintenance Dredging Samples[2]										
B401-SS-A	B401-SS-A[3]	0–10 cm	**1,528 J**	**26.7 J**		1.53 U				**204 J**
B401-SS-B	B401-SS-B[3]	0–10 cm	**434 J**	7.24 U		1.44 U				**44.4 J**
Berth 410 Post-Maintenance Dredging Samples[2]										
410A-PD	410A-PD[3]	0–10 cm	**2,064 J**	7.18 U		1.77 U				**254 J**
410B-PD	410B-PD[3]	0–10 cm	**880 J**	3.11 U		1.61 U				**117 J**
410C-PD	410C-PD[3]	0–10 cm	**1,344 J**	5.19 U		1.3 U				**194 J**
Slip 1										
LW2-B009	B009	0–15 cm	**110 JT**	2.1 UT		**0.92 JNT**	2.40E-05 U	**0.011745**	1.70E-05 U	**15 JT**
LW2-B010	B010	0–15 cm	**7,300 T**	**33 T**		**1.85 JNT**	**0.000769 J**	**0.002385**	6.30E-05 U	**1,300 T**
LW2-G149	G149	0–30 cm	**780 T**		**13 JT**	**14 JT**				**130 T**
LW2-GBT007	BT007	0–10 cm	**190 JT**		**5 JT**	**4.9 JT**	**7.00E-05 J**	4.90E-05 U	1.60E-05 U	**23 JT**
LW2-GBT008	BT008	0–10 cm	**9,600 T**		**69 T**	**19 JT**	**0.000158 J**	**0.008333**	2.30E-05 U	**1,500 T**
LWG0104R003SDS015C00	04R003	0–15 cm	**12,000 JT**	**50 T**		4 UJT				**1800 T**
WLCDRD05PG009	WR-PG-09	0–30 cm	**550 JT**	**35 T**		**6.7 JT**				**81 T**
WLCOFJ0252C01	52C01	0–10 cm	**8,790 JT**			23 UT				**1,350 JT**
WLCOFJ0252C02	52C02	0–15 cm	**860 JT**			2.48 UT				**140 T**
WLCOFJ0252C03	52C03	0–15 cm	**1,600 T**			2.49 UT				**260 T**
WLCOFJ0252C04	52C04	0–15 cm	**1,430 T**			2.41 UT				**155 T**
WLCOFJ0252C05	52C05	0–15 cm	**14,000 JT**			23.1 UT				**2,100 JT**
WLCT4C04UP01	T4-UP01	0–30 cm	**5,000 T**	**80 JT**		**21 T**				**460 T**
WLCT4C04UP02	T4-UP02	0–30 cm	**170 JT**	**27 JT**		**1.9 JT**				**18 JT**
WLCT4C04UP03	T4-UP03	0–0 cm	**210 JT**	9.9 UT		**1.4 JT**				**23 JT**
WLCT4C04UP04	T4-UP04	0–0 cm	**370 JT**	**29 T**		**3.1 JT**				**52 T**
WLCT4C04UP05	T4-UP05	0–0 cm	**300 JT**	10 UT		**2.9 JT**				**35 JT**
WLCT4C04UP06	T4-UP06	0–30 cm	**8,200 T**	**140 T**		**15 JT**				**1,100 T**
WLCT4C04UP07	T4-UP07	0–30 cm	**19,000 T**	**88 JT**		**14 JT**				**1,600 T**
WLCT4C04UP08	T4-UP08	0–30 cm	**730 JT**	**31 T**		**1.4 JT**				**59 T**
WR-WSI98SD021	SD021	0–10 cm	**2,400 T**	39 UJT		**10 AT**				**370 T**
WR-WSI98SD022	SD022	0–10 cm	**11,000 T**							**1,900 T**
WR-WSI98SD036	SD036	0–10 cm	**2,800 T**							**200 T**
WR-WSI98SD040	SD040	0–10 cm	**2,200 T**							**320 T**
WLCT4C04VC02	T4-VC02	0-30 cm	**1,000 JT**	**39 T**		**18 JT**				**140 T**
WLCT4C04VC03	T4-VC03	0-30 cm	**730 JT**	**32 JT**		**6.2 JT**				**81 T**
WLCT4C04VC04	T4-VC04	0-30 cm	**2,600 T**	**31 T**		**6.5 JT**				**310 T**
WLCT4C04VC05	T4-VC05	0-30 cm	**5,600 T**	**60 T**		**13 JT**				**820 T**

Table 2-3
Summary of Existing Surface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total PCB Congener (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**								
WLCT4C04VC06	T4-VC06	0-30 cm	**10,000 T**	**70 T**		**16 JT**				**1,600 T**
WLCT4C04VC07	T4-VC07	0-30 cm	**21,000 T**	**78 T**		**11 JT**				**3,200 T**
WLCT4C04VC08	T4-VC08	0-30 cm	**11,000 T**	**82 T**		**11 JT**				**1,600 T**
WLCT4C04VC09	T4-VC09	0-30 cm	**37,000 T**	**150 JT**		**19 JT**				**5,900 T**
WLCT4C04VC10	T4-VC10	0-30 cm	**64 JT**	10 UT		0.4 UT				**6.5 JT**
WLCT4C04VC11	T4-VC11	0-30 cm	**2,700 T**	**46 T**		**7.4 JT**				**370 T**
WLCT4C04VC12	T4-VC12	0-30 cm	**61,000 JT**	**50 JT**		**6.7 JT**				**8,900 JT**
WLCT4C04VC13	T4-VC13	0-30 cm	**5,300 JT**	**1,000 T**		**79 T**				**120 T**
WLCT4C04VC14	T4-VC14	0-30 cm	**53 JT**	**28 T**		**1.9 JT**				**4.5 JT**
WLCT4C04VC15	T4-VC15	0-30 cm	**21,000 T**	**140 T**		**21 JT**				**3,200 T**
WLCT4C04VC16	T4-VC16	0-30 cm	**56,000 T**	**150 T**		**22 JT**				**8,400 T**
WR-WSI98SD023	SD023	0–10 cm	**39,000 T**							**7,000 T**
Wheeler Bay										
LW2-B011	B011	0–15 cm	**7 JT**	2 UT		**1.3 NJT**	1.50E-05 U	1.40E-05 U	1.10E-05 U	**0.42 JT**
LW2-GBT009	BT009	0–10 cm	**14,000 T**		**35 JT**	**13.9 JT**	2.00E-05 U	**0.000543 J**	1.50E-05 U	**2,300 T**
WLCDRD05PG011	WR-PG-11	0–30 cm	**1,400 T**	**97 JT**		**11 JT**				**210 T**
WLCT4G06T4WB01	T4-WB-01	0–15 cm	**3,800 T**							**560 T**
WLCT4G06T4WB02	T4-WB-02	0–15 cm	**1,700 JT**							**250 JT**
WLCT4G06T4WB03	T4-WB-03	0–15 cm	**3,000 T**							**420 T**
WLCT4G06T4WB04	T4-WB-04	0–15 cm	**1,800 T**							**220 T**
WLCT4J98HCS41	HC-S-41	0–10 cm	**180,000 T**							**30,000 T**
WLCT4J98HCS43	HC-S-43	0–10 cm	**11,000 T**			**28 AJT**				**1,600 T**
WLCT4J98HCS44	HC-S-44	0–10 cm	**9,800 T**							**1,100 T**
WR-WSI98SD025	SD025	0–10 cm	**2,300 T**							**330 T**
WR-WSI98SD027	SD027	0–10 cm	**5,100 T**							**920 T**
WLCT4C04UP10	T4-UP10	0-30 cm	**6,900 T**	**40 JT**		**5.4 T**				**1,000 T**
WLCT4C04VC17	T4-VC17	0-30 cm	**1,500 T**	**35 JT**		**7.2 T**				**170 T**
WLCT4C04VC18	T4-VC18	0-30 cm	**2,600 T**	**68 T**		**16 JT**				**350 T**
WLCT4C04VC19	T4-VC19	0-30 cm	**36,000 T**	**67 JT**		**7.5 JT**				**5,600 T**
WLCT4C04VC20	T4-VC20	0-30 cm	**1,800 T**	**38 T**		**10 T**				**240 T**
WLCT4C04VC21	T4-VC21	0-30 cm	**2,700 T**	**50 T**		**37 JT**				**380 T**
WLCT4J98HCS42	HC-S-42	0–10 cm	**130,000 T**							**21,000 T**
Slip 3										
LW2-GBT010	BT010	0–10 cm	**1,800 T**		**12 JT**	**16.1 JT**	2.30E-05 U	**0.000102 J**	1.20E-05 U	**220 T**
WLCDRD05PG013	WR-PG-13	0–30 cm	**8,300 T**	**45 JT**		**12 JT**				**1,200 T**
WLCT4C04UP12	T4-UP12	0–30 cm	**140,000 JT**	**33 T**		**1.8 JT**				**25,000 JT**

Table 2-3
Summary of Existing Surface Sediment Data

		Focused COC	LWG RA Total PAH (Calculated U = 1/2)	LWG RA Total PCB Aroclors (Calculated U = 1/2)	LWG RA Total PCB Congener (Calculated U = 1/2)	LWG RA Total DDx (Calculated U = 1/2)	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF)	2,3,7,8-Tetrachlorodibenzo-p-dioxin	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2)
		Unit	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
		RAL[1]	13,000	75	75	160	0.0008	0.2	0.0006	106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**								
WLCT4C04UP13	T4-UP13	0–30 cm	**480,000 T**	**55 T**		**15 T**				**67,000 T**
WLCT4C04UP14	T4-UP14	0–0 cm	**32,000 T**	100 UT		**39 JT**				**4,500 T**
WLCT4J98HCS04	HC-S-04	0–10 cm	**140,000 T**							**21,000 T**
WLCT4J98HCS05	HC-S-05	0–10 cm	**100,000 JT**							**13,000 JT**
WLCT4J98HCS06	HC-S-06	0–10 cm	**80,000 JT**							**12,000 JT**
WLCT4J98HCS08	HC-S-08	0–10 cm	**96,000 T**							**15,000 T**
WLCT4J98HCS14	HC-S-14	0–10 cm	**67,000 JT**							**7,500 JT**
WLCT4J98HCS16	HC-S-16	0–10 cm	**120,000 T**			**39 AJT**				**16,000 T**
WLCT4J98HCS20	HC-S-20	0–10 cm	**170,000 T**							**26,000 T**
WLCT4J98HCS25	HC-S-25	0–10 cm	**17,000 T**							**2,000 T**
WLCT4J98HCS26	HC-S-26	0–10 cm	**30,000 JT**							**3,800 JT**
WLCT4J98HCS28	HC-S-28	0–10 cm	**41,000 T**			**23 AJT**				**5,800 T**
WLCT4J98HCS34	HC-S-34	0–10 cm	**11,000 T**							**860 T**
WLCT4J98HCS36	HC-S-36	0–10 cm	**2,300 T**			**15 AJT**				**300 T**
WLCT4J98HCS40	HC-S-40	0–10 cm	**18,000 T**							**2,500 T**
WLCT4L08T4IM02	T4-IM-02	0-6 cm	**704 JT**							**120 JT**
WLCT4L08T4IM03	T4-IM-03	0-15 cm	**21,600 JT**							**3,720 T**
WLCT4L08T4IM04	T4-IM-04	0-18 cm	**100,000 JT**							**17,900 JT**
WLCT4L08T4IM05	T4-IM-05	0-15 cm	**84,000 JT**							**14,000 JT**
WLCT4L08T4IM06	T4-IM-06	0-18 cm	**348,000 T**							**60,600 T**
WLCT4L08T4IM07	T4-IM-07	0-6 cm	**77,000 JT**							**12,000 JT**
WLCT4L08T4IM08	T4-IM-08	0-3 cm	**1,700 JT**							**266 T**
WLCT4L08T4IM09	T4-IM-09	0-9 cm	**370,000 JT**							**60,100 JT**
WLCT4L08T4IM10	T4-IM-10	0-9 cm	**16,000 JT**							**2,530 T**
WLCT4L08T4IM11	T4-IM-11	0-15 cm	**8,400 T**							**1,120 T**
WLCT4L08T4IM12	T4-IM-12	0-15 cm	**49,000 T**							**6,500 T**
WLCT4L08T4IM13	T4-IM-13	0-15 cm	**380 JT**							**65 JT**
WLCT4L08T4IM14	T4-IM-14	0-15 cm	**1,160 T**							**175 T**
WLCT4L08T4IMC01	T4-IM-Comp01	0-15 cm		**48.1 T**		**8.32 JT**				
WLCT4L08T4IMC02	T4-IM-Comp02	0-9 cm		3.78 UT		0.897 UJT				
WLCT4L08T4IMC03	T4-IM-Comp03	0-18 cm		**51.1 T**		**9.03 JT**				
WLCT4L08T4IMC04	T4-IM-Comp04	0-15 cm		**28 JT**		**25 JT**				
WR-WSI98SD033	SD033	0–10 cm	**100,000 T**							**18,000 T**
WR-WSI98SD034	SD034	0–10 cm	**9,400 JT**	39 UJT		**3.1 AJT**				**1,500 T**
WLCT4C04VC22	T4-VC22	0-30 cm	**240 JT**	10 UT		0.4 UT				**33 JT**
WLCT4C04VC23	T4-VC23	0-30 cm	**14,000 T**	**34 T**		**8.3 JT**				**2,300 T**
WLCT4C04VC25	T4-VC25	0-30 cm	**28 JT**	10 UT		0.4 UT				**2.3 JT**

Table 2-3
Summary of Existing Surface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total PCB Congener (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**								
WLCT4C04VC26	T4-VC26	0-30 cm	**10,000 T**	**47 T**		**10 JT**				**1,500 T**
WLCT4C04VC27	T4-VC27	0-30 cm	**3,300 T**	**29 T**		**5 JT**				**380 T**
WLCT4C04VC28	T4-VC28	0-30 cm	**3,700 T**	10 UT		**1.4 JT**				**410 T**
WLCT4C04VC29	T4-VC29	0-30 cm	**50,000 T**	**70 T**		**12 JT**				**7,900 T**
WLCT4C04VC30	T4-VC30	0-30 cm	**1,200 JT**	**44 JT**		**10 JT**				**170 T**
WLCT4C04VC31	T4-VC31	0-30 cm	**7,500 JT**	**49 T**		**12 JT**				**1,100 T**
WLCT4C04VC32	T4-VC32	0-30 cm	**39,000 T**	**88 JT**		**23 JT**				**5,000 T**
WLCT4G06T4B41402	T4-B414-02	0-30 cm	**17,000 T**							**2,500 T**
WLCT4G06T4B41403	T4-B414-03	0-30 cm	**17,000 T**							**2,400 T**
WLCT4G06T4B41404	T4-B414-04	0-30 cm	**2,200 T**							**270 T**
WLCT4G06T4PI09	T4-PI-09	0-30 cm	**1,400 JT**	**19 T**		**69 JT**				**210 JT**
WLCT4G06T4S306	T4-S3-06	0-30 cm	**25,000 T**							**3,800 T**
WLCT4J98HCS07	HC-S-07	0–10 cm	**130,000 JT**							**18,000 JT**
WLCT4J98HCS11	HC-S-11	0–10 cm	**130,000 JT**							**19,000 JT**
WLCT4J98HCS13	HC-S-13	0–10 cm	**58,000 JT**							**8,000 JT**
WLCT4J98HCS22	HC-S-22	0–10 cm	**48,000 T**							**7,100 T**
WLCT4J98HCS32	HC-S-32	0–10 cm	**14,000 JT**							**2,300 JT**
WLCT4J98HCS39	HC-S-39	0–10 cm	**78,000 JT**			**7 AJT**				**11,000 JT**
WR-WSI98SD031	SD031	0–10 cm	**42,000 T**							**7,100 T**

Notes:

Result is above the Remedial Action Level for Alternative F Modified from the ROD (USEPA 2017a).

1. No RAL exists for cPAHs and the value provided is a principal threat waste threshold.
2. All data are from USEPA's FS database (USEPA 2016), with the exception of five additional surface sediment samples: two from the Berth 401 dredge area (collected in 2015) and three from the Berth 410 dredge area (collected in 2017). These samples were included for reference but were not used to define the SMAs shown in the figures in this report. SMAs were defined by USEPA in the ROD and are unchanged in figures in this report.
3. Non-detects treated as zero in calculated results.
4. Data from Berths 401 and 414 are included with the datasets for Slips 1 and 3, respectively.

Bold: Detected result

A: total value based on limited number of analytes
J: estimated result
T: value is an average or selected result
U: undetected
µg/kg: micrograms per kilogram
cm: centimeter
BaP Eq: benzo(a)pyrene equivalent
cPAH: carcinogenic polycyclic aromatic hydrocarbon
DDx: dichlorodiphenyldichloroethane + dichlorodiphenyldichloroethene + dichlorodiphenyltrichloroethane
FS: Feasibility Study
LWG: Lower Willamette Group
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PeCDD: 1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF: 2,3,4,7,8-pentachlorodibenzofuran
RA: Risk Assessment
ROD: Record of Decision
SMA: sediment management area
TCDD: 2,3,7,8-tetrachlorodibenzo-p-dioxin
TEQ: toxic equivalents quotient
USEPA: U.S. Environmental Protection Agency

Table 2-4
RAL Exceedance Summary: Terminal 4

COC	No. of Locations[1,2]	No. of Locations with RAL Exceedances	% of Locations with RAL Exceedances	No. of Samples	No. of Samples with RAL Exceedances	% of Samples with RAL Exceedances
Surface Sediment						
PAHs	119	48	40%	119	48	40%
PCBs	66	12	18%	66	12	18%
DDx	76	0	0%	76	0	0%
D/F	7	0	0%	7	0	0%
Subsurface Sediment						
PAHs	67	19	28%	231	39	17%
PCBs	47	20	43%	165	41	25%
DDx	47	2	4%	165	2	1%
D/F	3	0	0%	3	0	0%

Notes:
1. All data are from USEPA's FS database (USEPA 2016), with the exception of three additional surface and subsurface sediment samples from the 2017 Berth 410 maintenance dredge area and two surface post-dredge samples from the Berth 401 maintenance dredge area; those samples were included for reference but were not used to define the SMAs shown in the figures in this report. SMAs were defined by USEPA in the ROD and are unchanged in figures in this report.
2. Includes all locations within the T4 Sediment Decision Unit; note that some locations are outside of the ROD SMA.
COC: contaminant of concern
D/F: dioxins/furans
DDx: dichlorodiphenyldichloroethane + dichlorodiphenyldichloroethene + dichlorodiphenyltrichloroethane
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RAL: Alternative F Modified remedial action level
ROD: Record of Decision
SMA: sediment management area
T4: Terminal 4
USEPA: U.S. Environmental Protection Agency

Table 2-5
Summary of Existing Subsurface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**							
Berth 410 Maintenance Dredging Samples[2]									
410A	410A-Z[3]	0-2 feet	**1,647 J**	**8.68 J**	**14.5 J**	**0.000689 J**	**0.00209 J**	0.00015 UJ	**181 J**
410B	410B-Z[3]	0-2 feet	**1,366 J**	**15.2 J**	**6.6**	**0.000366 J**	0.000224 UK	0.000212 UJ	**104 J**
410C	410C-Z[3]	0-2 feet	**564 J**	**6.28 J**	**0.71**	**0.000176 J**	0.000104 U	0.000106 UJ	**78 J**
Slip 1									
WLCT4C04PS03	T4-PS03	11-13 feet	**150 JT**	11 UT	0.43 UT				**13 JT**
WLCT4C04PS03	T4-PS03	15-17 feet	**32 JT**	11 UT	0.43 UT				**4.7 JT**
WLCT4C04PS04	T4-PS04	10-12 feet	**1,500 JT**	**29 JT**	**4.1 JT**				**160 JT**
WLCT4C04PS04	T4-PS04	15-17 feet	**40 JT**	11 UT	0.42 UT				**5.4 JT**
WLCT4C04PS12	T4-PS12	10-12 feet	**120 JT**	11 UT	0.43 UT				**14 JT**
WLCT4C04PS12	T4-PS12	15-17 feet	**34 JT**	11 UT	0.43 UT				**5.5 JT**
WLCT4C04VC02	T4-VC02	5-7 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC02	T4-VC02	7-9 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC02	T4-VC02	1-3 feet	**3,500 T**	**250 T**	**27 JT**				**340 T**
WLCT4C04VC02	T4-VC02	3-5 feet	**56 JT**	10 UT	**1.1 JT**				**8.8 JT**
WLCT4C04VC03	T4-VC03	5-7 feet	**96 JT**	10 UT	0.4 UT				**5.2 JT**
WLCT4C04VC03	T4-VC03	1-3 feet	**870 JT**	10 UT	**1.1 JT**				**71 JT**
WLCT4C04VC03	T4-VC03	3-5 feet	**22 JT**	10 UT	0.4 UT				**2.7 JT**
WLCT4C04VC04	T4-VC04	5-7 feet	**46 JT**	10 UT	0.4 UT				**6.2 JT**
WLCT4C04VC04	T4-VC04	7-9 feet	**250 JT**	11 UT	**1.1 JT**				**31 JT**
WLCT4C04VC04	T4-VC04	1-3 feet	**1,900 T**	**44 T**	**22 JT**				**250 T**
WLCT4C04VC04	T4-VC04	3-5 feet	**840 JT**	**26 JT**	**1.8 JT**				**93 JT**
WLCT4C04VC05	T4-VC05	5-7 feet	**38 JT**	11 UT	0.42 UT				**5.8 JT**
WLCT4C04VC05	T4-VC05	7-9 feet	5 UT	11 UT	0.42 UT				5 UT
WLCT4C04VC05	T4-VC05	1-3 feet	**2,500 T**	**96 JT**	**12 JT**				**370 T**
WLCT4C04VC05	T4-VC05	3-5 feet	**480 JT**	**37 JT**	**4.4 JT**				**27 JT**
WLCT4C04VC06	T4-VC06	5-7 feet	**36 JT**	10 UT	0.4 UT				**5.8 JT**
WLCT4C04VC06	T4-VC06	7-9 feet	**27 JT**	10 UT	0.4 UT				**3 JT**
WLCT4C04VC06	T4-VC06	1-3 feet	**1,900 T**	**50 T**	**5.4 JT**				**150 T**
WLCT4C04VC06	T4-VC06	3-5 feet	**38 JT**	10 UT	0.4 UT				5 UT
WLCT4C04VC07	T4-VC07	5-7 feet	**240 JT**	**26 JT**	**1.5 JT**				**20 JT**
WLCT4C04VC07	T4-VC07	7-9 feet	**23 JT**	10 UT	**1.1 JT**				**3 JT**
WLCT4C04VC07	T4-VC07	1-3 feet	**9,400 T**	**290 T**	**35 JT**				**760 T**
WLCT4C04VC07	T4-VC07	3-5 feet	**1,800 T**	**110 T**	**13 JT**				**200 T**
WLCT4C04VC08	T4-VC08	5-7 feet	**40 JT**	10 UT	0.4 UT				**5.6 JT**
WLCT4C04VC08	T4-VC08	7-9 feet	**40 JT**	9.6 UT	0.39 UT				**5.6 JT**

Table 2-5
Summary of Existing Subsurface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**							
WLCT4C04VC08	T4-VC08	9-11 feet	**40 JT**	11 UT	0.43 UT				**5.6 JT**
WLCT4C04VC08	T4-VC08	1-3 feet	**190 JT**	10 UT	**1.2 JT**				**23 JT**
WLCT4C04VC08	T4-VC08	3-5 feet	**31 JT**	10 UT	0.4 UT				**5.2 JT**
WLCT4C04VC09	T4-VC09	5-7 feet	**31 JT**	9.6 UT	0.39 UT				**5.4 JT**
WLCT4C04VC09	T4-VC09	7-9 feet	**34 JT**	9.9 UT	0.4 UT				**5.4 JT**
WLCT4C04VC09	T4-VC09	9-11 feet	**41 JT**	10 UT	0.4 UT				**5.6 JT**
WLCT4C04VC09	T4-VC09	1-3 feet	**22,000 T**	**150 JT**	**16 JT**				**3,500 T**
WLCT4C04VC09	T4-VC09	3-5 feet	**4,600 T**	**320 JT**	**35 JT**				**470 T**
WLCT4C04VC10	T4-VC10	5-7 feet	**35 JT**	10 UT	0.52 UT				**5.5 JT**
WLCT4C04VC10	T4-VC10	7-9 feet	**41 JT**	10 UT	0.4 UT				**5.6 JT**
WLCT4C04VC10	T4-VC10	9-11 feet	**32 JT**	10 UT	0.4 UT				**5.3 JT**
WLCT4C04VC10	T4-VC10	1-3 feet	**100 JT**	10 UT	**1.5 T**				**11 JT**
WLCT4C04VC10	T4-VC10	11-13 feet	**31 JT**	9.8 UT	0.4 UT				**3.6 JT**
WLCT4C04VC10	T4-VC10	3-5 feet	**38 JT**	9.8 UT	0.4 UT				**5.6 JT**
WLCT4C04VC11	T4-VC11	5-7 feet	**46 JT**	10 UT	**1.1 JT**				**2.5 JT**
WLCT4C04VC11	T4-VC11	7-9 feet	5 UJT	10 UT	0.4 UT				5 UJT
WLCT4C04VC11	T4-VC11	9-11 feet	5 UJT	10 UT	0.4 UT				5 UJT
WLCT4C04VC11	T4-VC11	1-3 feet	**3,200 T**	**53 T**	**12 JT**				**490 T**
WLCT4C04VC11	T4-VC11	3-5 feet	**480 JT**	**100 T**	**7.2 T**				**39 JT**
WLCT4C04VC12	T4-VC12	5-7 feet	**27 JT**	10 UT	0.4 UT				**1.1 JT**
WLCT4C04VC12	T4-VC12	7-9 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC12	T4-VC12	1-3 feet	**3,800 T**	**150 JT**	**23 JT**				**340 T**
WLCT4C04VC12	T4-VC12	3-5 feet	**3,800 T**	**140 T**	**45 JT**				**250 T**
WLCT4C04VC13	T4-VC13	5-7 feet	**22 JT**	11 UT	0.43 UT				**3.5 JT**
WLCT4C04VC13	T4-VC13	7-9 feet	**220 JT**	11 UT	0.42 UT				**16 JT**
WLCT4C04VC13	T4-VC13	1-3 feet	**480 JT**	**60 T**	**4.8 JT**				**51 T**
WLCT4C04VC13	T4-VC13	3-5 feet	**23 JT**	10 UT	0.4 UT				**3.5 JT**
WLCT4C04VC14	T4-VC14	5-7 feet	**3,400 T**	**86 T**	**14 JT**				**420 T**
WLCT4C04VC14	T4-VC14	7-9 feet	**39 JT**	10 UT	0.4 UT				**3.3 JT**
WLCT4C04VC14	T4-VC14	1-3 feet	**55 JT**	**28 T**	**2.1 JT**				**5.6 JT**
WLCT4C04VC14	T4-VC14	3-5 feet	**700 JT**	**29 JT**	**3.9 JT**				**99 T**
WLCT4C04VC15	T4-VC15	5-7 feet	**32 JT**	10 UT	0.4 UT				**5.3 JT**
WLCT4C04VC15	T4-VC15	7-9 feet	**32 JT**	10 UT	0.4 UT				**3.6 JT**
WLCT4C04VC15	T4-VC15	9-11 feet	**32 JT**	10 UT	0.4 UT				**5.3 JT**
WLCT4C04VC15	T4-VC15	1-3 feet	**6,500 T**	**340 T**	**46 JT**				**660 T**
WLCT4C04VC15	T4-VC15	3-5 feet	**1,700 T**	**43 T**	**3.6 JT**				**170 T**
WLCT4C04VC16	T4-VC16	5-7 feet	**28 JT**	13 UT	0.5 UT				**2.9 JT**

Table 2-5
Summary of Existing Subsurface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**							
WLCT4C04VC16	T4-VC16	7-9 feet	**38 JT**	9.9 UT	0.4 UJT				**5.2 JT**
WLCT4C04VC16	T4-VC16	9-11 feet	**38 JT**	9.7 UT	0.39 UJT				**5.5 JT**
WLCT4C04VC16	T4-VC16	1-3 feet	**3,000 JT**	**68 JT**	**9.2 JT**				**290 T**
WLCT4C04VC16	T4-VC16	3-5 feet	**27 JT**	12 UT	0.48 UJT				**2.8 JT**
WR-WSI98SD023	SD023	0-3 feet	**8,500 T**						**1,400 T**
Wheeler Bay									
WLCT4C04PS17	T4-PS17	10-12 feet	**500 JT**	11 UT	**5.4 JT**				**46 JT**
WLCT4C04PS17	T4-PS17	15-17 feet	**61 JT**	11 UT	0.43 UT				**7.3 JT**
WLCT4C04PS20	T4-PS20	15-17 feet	**13,000 JT**	**160 JT**	**27 JT**				**740 JT**
WLCT4C04PS20	T4-PS20	20-22 feet	**2,100 JT**	**44 JT**	**7.8 JT**				**84 JT**
WLCT4C04PS21	T4-PS21	15-17 feet	**12,000 JT**	**40 JT**	**2 T**				**1,400 JT**
WLCT4C04PS21	T4-PS21	20-22 feet	**4,200 JT**	10 UT	0.4 UT				**510 JT**
WLCT4C04UP09	T4-UP09	0-2 feet	**4,200 T**	**34 T**	**6.9 JT**				**350 T**
WLCT4C04UP10	T4-UP10	0-2 feet	**9,700 JT**	**40 T**	**6.8 T**				**1,300 JT**
WLCT4C04VC17	T4-VC17	5-7 feet	**4,600 T**	**51 T**	**1.6 T**				**390 T**
WLCT4C04VC17	T4-VC17	1-3 feet	**4,400 T**	**130 T**	**20 JT**				**560 T**
WLCT4C04VC17	T4-VC17	3-5 feet	**14,000 T**	**390 JT**	**110 JT**				**1,300 T**
WLCT4C04VC18	T4-VC18	5-7 feet	**3,900 T**	**42 JT**	**12 JT**				**330 T**
WLCT4C04VC18	T4-VC18	7-9 feet	**1,400 JT**	10 UT	**19 JT**				**290 JT**
WLCT4C04VC18	T4-VC18	1-3 feet	**4,400 T**	**79 T**	**14 JT**				**300 T**
WLCT4C04VC18	T4-VC18	3-5 feet	**2,400 T**	**110 T**	**22 T**				**150 T**
WLCT4C04VC19	T4-VC19	5-7 feet	**5,000 JT**	**75 JT**	**13 JT**				**380 JT**
WLCT4C04VC19	T4-VC19	7-9 feet	**3,900 T**	10 UT	**9.9 JT**				**420 T**
WLCT4C04VC19	T4-VC19	9-11 feet	**1,200 T**	10 UT	**2.9 JT**				**130 T**
WLCT4C04VC19	T4-VC19	1-3 feet	**120,000 T**	**75 JT**	**13 JT**				**18,000 T**
WLCT4C04VC19	T4-VC19	3-5 feet	**8,500 T**	**110 T**	**20 JT**				**1,200 T**
WLCT4C04VC20	T4-VC20	5-7 feet	**2,300 T**	**160 T**	**24 JT**				**240 T**
WLCT4C04VC20	T4-VC20	7-9 feet	**3,800 T**	**350 T**	**49 JT**				**370 T**
WLCT4C04VC20	T4-VC20	9-11 feet	**4,500 T**	**410 T**	**45 JT**				**210 T**
WLCT4C04VC20	T4-VC20	1-3 feet	**1,300 JT**	**46 JT**	**8.4 JT**				**180 T**
WLCT4C04VC20	T4-VC20	11-13 feet	**9,400 T**	**150 T**	**26 JT**				**880 T**
WLCT4C04VC20	T4-VC20	3-5 feet	**7,700 T**	**58 JT**	**10 JT**				**1,200 T**
WLCT4C04VC21	T4-VC21	5-7 feet	**3,100 T**	**210 T**	**30 JT**				**200 T**
WLCT4C04VC21	T4-VC21	7-9 feet	**6,200 T**	**130 T**	**27 JT**				**200 T**
WLCT4C04VC21	T4-VC21	9-11 feet	**7,000 T**	**110 T**	**22 JT**				**440 T**
WLCT4C04VC21	T4-VC21	1-3 feet	**1,200 T**	**40 T**	**9.8 T**				**170 T**
WLCT4C04VC21	T4-VC21	11-13 feet	**4,600 T**	**100 JT**	**1.3 JT**				**510 T**

Table 2-5
Summary of Existing Subsurface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**							
WLCT4C04VC21	T4-VC21	3-5 feet	**7,000 T**	**84 T**	**12 JT**				**1,100 T**
WLCT4J98HCS42	HC-S-42	0-2 feet	**110,000 T**						**17,000 T**
WLCT4J98HCS42	HC-S-42	2-4 feet	**220,000 T**						**33,000 T**
Slip 3									
WLCT4C04PS22	T4-PS22	15-17 feet	**31 JT**	10 UT	0.4 UT				**4.1 JT**
WLCT4C04PS22	T4-PS22	20-22 feet	**33 JT**	10 UT	0.4 UT				**4.6 JT**
WLCT4C04PS28	T4-PS28	10-12 feet	**47 JT**	11 UT	0.43 UT				**5.7 JT**
WLCT4C04PS28	T4-PS28	15-17 feet	**39 JT**	11 UT	0.42 UT				**4.7 JT**
WLCT4C04PS31	T4-PS31	15-17 feet	**810 JT**	10 UT	**12 JT**				**67 JT**
WLCT4C04PS31	T4-PS31	20.5-22.5 feet	**130 JT**	10 UT	**1.5 JT**				**12 JT**
WLCT4C04PS32	T4-PS32	10-12 feet	**640 JT**	11 UT	**1.8 JT**				**80 JT**
WLCT4C04PS32	T4-PS32	15-17 feet	**2,000 JT**	11 UT	**1.4 JT**				**240 JT**
WLCT4C04VC22	T4-VC22	5-7 feet	**38 JT**	10 UT	0.4 UT				5 UT
WLCT4C04VC22	T4-VC22	7-9 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC22	T4-VC22	9-11 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC22	T4-VC22	1-3 feet	**40 JT**	10 UT	0.4 UT				5 UT
WLCT4C04VC22	T4-VC22	3-5 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC23	T4-VC23	5-7 feet	**39 JT**	10 UT	0.4 UT				5.1 UT
WLCT4C04VC23	T4-VC23	7-9 feet	**38 JT**	10 UT	0.55 UT				5 UT
WLCT4C04VC23	T4-VC23	9-11 feet	**38 JT**	12 UT	**1.5 JT**				**5.2 JT**
WLCT4C04VC23	T4-VC23	1-3 feet	**180 JT**	10 UT	0.4 UT				**25 JT**
WLCT4C04VC23	T4-VC23	3-5 feet	**38 JT**	10 UT	0.4 UT				5 UT
WLCT4C04VC25	T4-VC25	5-7 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC25	T4-VC25	7-9 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC25	T4-VC25	9-11 feet	**33 JT**	10 UT	0.4 UT				**5.5 JT**
WLCT4C04VC25	T4-VC25	1-3 feet	**18 JT**	10 UT	0.4 UT				**3 JT**
WLCT4C04VC25	T4-VC25	3-5 feet	**31 JT**	10 UT	0.4 UT				**5.5 JT**
WLCT4C04VC26	T4-VC26	0-3 feet	**22,000 T**	**74 T**	**12 JT**				**3,700 T**
WLCT4C04VC26	T4-VC26	5-7 feet	**360 JT**	**79 T**	**8.8 JT**				**29 JT**
WLCT4C04VC26	T4-VC26	7-9 feet	**28 JT**	11 UT	0.41 UT				**3.8 JT**
WLCT4C04VC26	T4-VC26	3-5 feet	**5,600 T**	**240 T**	**29 JT**				**830 T**
WLCT4C04VC27	T4-VC27	5-7 feet	**21 JT**	11 UT	0.41 UT				**2.8 JT**
WLCT4C04VC27	T4-VC27	7-9 feet	**38 JT**	10 UT	0.4 UT				5 UT
WLCT4C04VC27	T4-VC27	1-3 feet	**140 JT**	10 UT	0.4 UT				**13 JT**
WLCT4C04VC27	T4-VC27	3-5 feet	**38 JT**	10 UT	0.4 UT				5 UT
WLCT4C04VC28	T4-VC28	5-7 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC28	T4-VC28	7-9 feet	**40 JT**	10 UT	0.4 UT				5 UT

Table 2-5
Summary of Existing Subsurface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**							
WLCT4C04VC28	T4-VC28	1-3 feet	**34 JT**	10 UT	0.4 UT				**5.8 JT**
WLCT4C04VC28	T4-VC28	3-5 feet	5 UT	10 UT	0.4 UT				5 UT
WLCT4C04VC29	T4-VC29	5-7 feet	**36 JT**	10 UT	0.4 UT				5 UT
WLCT4C04VC29	T4-VC29	7-9 feet	5 UT	10 UT	0.4 UT				4.9 UT
WLCT4C04VC29	T4-VC29	9-11 feet	**40 JT**	10 UT	0.4 UT				**5.6 JT**
WLCT4C04VC29	T4-VC29	1-3 feet	**85,000 T**	**1,300 T**	**190 JT**				**13,000 T**
WLCT4C04VC29	T4-VC29	3-5 feet	**33,000 T**	**52 T**	**8.1 JT**				**5,000 T**
WLCT4C04VC30	T4-VC30	5-7 feet	**3,700 T**	**150 T**	**31 T**				**370 T**
WLCT4C04VC30	T4-VC30	7-9 feet	**4,800 T**	**210 T**	**42 JT**				**460 T**
WLCT4C04VC30	T4-VC30	9-11 feet	**28 JT**	10 UT	0.4 UT				**3.3 JT**
WLCT4C04VC30	T4-VC30	1-3 feet	**2,300 T**	**110 T**	**14 JT**				**340 T**
WLCT4C04VC30	T4-VC30	3-5 feet	**4,500 T**	**250 T**	**39 JT**				**610 T**
WLCT4C04VC31	T4-VC31	5-7 feet	**1,800 T**	**93 JT**	**31 JT**				**210 T**
WLCT4C04VC31	T4-VC31	7-9 feet	**6,300 T**	**80 JT**	**1.3 JT**				**590 T**
WLCT4C04VC31	T4-VC31	9-11 feet	**3,700 T**	10 UT	**1.2 JT**				**380 T**
WLCT4C04VC31	T4-VC31	1-3 feet	**5,100 T**	**58 T**	**9.7 T**				**790 T**
WLCT4C04VC31	T4-VC31	3-5 feet	**1,300 T**	**150 T**	**20 JT**				**140 T**
WLCT4C04VC32	T4-VC32	5-7 feet	**33 JT**	11 UT	0.41 UT				**4.8 JT**
WLCT4C04VC32	T4-VC32	7-9 feet	**42 JT**	12 UT	0.46 UT				**6 JT**
WLCT4C04VC32	T4-VC32	1-3 feet	**36,000 T**	**130 T**	**18 JT**				**5,600 T**
WLCT4C04VC32	T4-VC32	3-5 feet	**70,000 JT**	**85 T**	**13 T**				**11,000 T**
WLCT4G06T4B41106	T4-B411-06	5-7 feet	**350,000 JT**	**130 T**	6.2 UT				**54,000 T**
WLCT4G06T4B41106	T4-B411-06	7-9 feet	**8,400 JT**	**200 T**	2.4 UT				**1,200 T**
WLCT4G06T4B41106	T4-B411-06	9-11 feet	**180,000 JT**	**140 T**	2.5 UT				**30,000 T**
WLCT4G06T4B41402	T4-B414-02	4-5 feet	**2,500 T**						**260 T**
WLCT4G06T4B41402	T4-B414-02	5-6 feet	**9,200 T**						**600 T**
WLCT4G06T4B41402	T4-B414-02	1-2 feet	**1,400 T**						**150 T**
WLCT4G06T4B41402	T4-B414-02	2-3 feet	**6,300 JT**						**900 T**
WLCT4G06T4B41402	T4-B414-02	3-4 feet	**2,900 T**						**290 T**
WLCT4G06T4B41403	T4-B414-03	1-2 feet	**15,000 T**						**2,100 T**
WLCT4G06T4B41403	T4-B414-03	2-3 feet	**1,500 T**						**200 T**
WLCT4G06T4B41404	T4-B414-04	4-5 feet	**9,900 T**						**1,400 T**
WLCT4G06T4B41404	T4-B414-04	5-6 feet	**3,400 T**						**440 T**
WLCT4G06T4B41404	T4-B414-04	1-2 feet	**1,900 T**						**250 T**
WLCT4G06T4B41404	T4-B414-04	2-3 feet	**4,700 JT**						**630 T**
WLCT4G06T4B41404	T4-B414-04	3-4 feet	**2,000 T**						**260 T**
WLCT4G06T4PI09	T4-PI-09	1-2 feet	**7,400 JT**	1.3 UT	**430 JT**				**650 JT**

Table 2-5
Summary of Existing Subsurface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**							
WLCT4G06T4S301	T4-S3-01	4-5 feet	**280,000 T**						**46,000 T**
WLCT4G06T4S301	T4-S3-01	5-6 feet	**390,000 JT**						**63,000 T**
WLCT4G06T4S301	T4-S3-01	6-7 feet	**230,000 JT**						**36,000 T**
WLCT4G06T4S301	T4-S3-01	7-8 feet	**490,000 T**						**80,000 T**
WLCT4G06T4S301	T4-S3-01	8-9 feet	**110,000 T**						**16,000 T**
WLCT4G06T4S301	T4-S3-01	9-9.9 feet	**620 T**						**89 T**
WLCT4G06T4S301	T4-S3-01	3-4 feet	**140,000 T**						**22,000 T**
WLCT4G06T4S302	T4-S3-02	4-5 feet	**140,000 T**						**22,000 T**
WLCT4G06T4S302	T4-S3-02	5-6 feet	**63,000 JT**						**9,900 T**
WLCT4G06T4S302	T4-S3-02	6-7 feet	**7,300 T**						**830 T**
WLCT4G06T4S302	T4-S3-02	7-8 feet	**6,400 T**						**760 T**
WLCT4G06T4S302	T4-S3-02	8-9 feet	**1,800 T**						**180 T**
WLCT4G06T4S302	T4-S3-02	9-9.9 feet	**460 JT**						**51 JT**
WLCT4G06T4S302	T4-S3-02	2-3 feet	**69,000 T**						**11,000 T**
WLCT4G06T4S302	T4-S3-02	3-4 feet	**150,000 T**						**25,000 T**
WLCT4G06T4S303	T4-S3-03	4-5 feet	**5,100 T**						**580 T**
WLCT4G06T4S303	T4-S3-03	5-6 feet	**1,500 T**						**160 T**
WLCT4G06T4S303	T4-S3-03	6-7 feet	**2,000 T**						**160 T**
WLCT4G06T4S303	T4-S3-03	1-3 feet	**61,000 T**						**8,700 T**
WLCT4G06T4S303	T4-S3-03	2-3 feet	**9,600 JT**						**1,200 T**
WLCT4G06T4S303	T4-S3-03	3-4 feet	**6,500 T**						**740 T**
WLCT4G06T4S305	T4-S3-05	4-5 feet	**48,000 T**						**7,500 T**
WLCT4G06T4S305	T4-S3-05	5-6 feet	**130,000 T**						**21,000 T**
WLCT4G06T4S305	T4-S3-05	6-7 feet	**250,000 T**						**41,000 T**
WLCT4G06T4S305	T4-S3-05	7-8 feet	**110,000 T**						**18,000 T**
WLCT4G06T4S305	T4-S3-05	8-9 feet	**4,000 T**						**630 T**
WLCT4G06T4S305	T4-S3-05	9-9.7 feet	**62 JT**						**7.1 JT**
WLCT4G06T4S306	T4-S3-06	1-2 feet	**270 T**						**40 T**
WLCT4G06T4S307	T4-S3-07	4-5 feet	**1,800 JT**						**270 T**
WLCT4G06T4S307	T4-S3-07	5-6 feet	**300 JT**						**47 T**
WLCT4G06T4S307	T4-S3-07	1-2 feet	**30,000 JT**						**4,400 T**
WLCT4G06T4S307	T4-S3-07	2-3 feet	**14,000 T**						**2,200 T**
WLCT4G06T4S307	T4-S3-07	3-4 feet	**32,000 JT**						**4,900 T**
WLCT4G06T4S308	T4-S3-08	1-2 feet	**37,000 T**						**6,100 T**
WLCT4G06T4S308	T4-S3-08	2-3 feet	**4,700 JT**						**670 JT**
WLCT4G06T4S308	T4-S3-08	3-4 feet	**1,900 JT**						**310 JT**
WLCT4J98HCS07	HC-S-07	0-2 feet	**200,000 T**						**32,000 T**

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Summary of Existing Subsurface Sediment Data

		Focused COC Unit RAL[1]	LWG RA Total PAH (Calculated U = 1/2) µg/kg 13,000	LWG RA Total PCB Aroclors (Calculated U = 1/2) µg/kg 75	LWG RA Total DDx (Calculated U = 1/2) µg/kg 160	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) µg/kg 0.0008	2,3,4,7,8-Pentachlorodibenzo furan (PeCDF) µg/kg 0.2	2,3,7,8-Tetrachlorodibenzo-p-dioxin µg/kg 0.0006	LWG RA Total cPAH/BaP Eq TEQ (USEPA 1993) (Calculated U = 1/2) µg/kg 106,000
Station ID from USEPA Database	**Location Name**	**Depth Interval**							
WLCT4J98HCS07	HC-S-07	2-4.2 feet	**110,000 T**						**16,000 T**
WLCT4J98HCS11	HC-S-11	0-2.1 feet	**77,000 T**						**11,000 T**
WLCT4J98HCS11	HC-S-11	2.1-4 feet	**160,000 T**						**25,000 T**
WLCT4J98HCS13	HC-S-13	0-2 feet	**2,400 T**						**330 T**
WLCT4J98HCS13	HC-S-13	2-4 feet	**2,200 T**						**360 T**
WLCT4J98HCS22	HC-S-22	0-2 feet	**2,800 T**						**390 T**
WLCT4J98HCS22	HC-S-22	2-4 feet	20 UT						20 UT
WLCT4J98HCS27	HC-S-27	0-1.9 feet	**43,000 T**						**6,200 T**
WLCT4J98HCS27	HC-S-27	1.9-3.5 feet	**47,000 T**						**6,800 T**
WLCT4J98HCS32	HC-S-32	0-1.8 feet	**5,300 JT**						**730 JT**
WLCT4J98HCS32	HC-S-32	1.8-4 feet	20 UT						20 UT
WLCT4J98HCS39	HC-S-39	0-2 feet	**8,900 JT**						**1,200 JT**
WLCT4J98HCS39	HC-S-39	2-4 feet	**6,000 JT**						**780 JT**
WR-WSI98SD031	SD031	0-3 feet	**140,000 T**						**25,000 T**

Notes:

Result is above the Remedial Action Level for Alternative F Modified from the ROD (USEPA 2017a).

1. No RAL exists for cPAHs and the value provided is a principal threat waste threshold.
2. All data are from USEPA's FS database (USEPA 2016), with the exception of three additional subsurface sediment samples from the Berth 410 maintenance dredge area (collected in 2016). The Berth 410 samples were included for reference but were not used to define the SMAs shown in the figures in this report. SMAs were defined by USEPA in the ROD and are unchanged in figures in this report.
3. Non-detects treated as zero in calculated results.
4. Data from Berths 401 and 414 are included with the datasets for Slips 1 and 3, respectively.

Bold: Detected result

A: total value based on limited number of analytes
J: estimated result
T: value is an average or selected result
U: undetected
µg/kg: micrograms per kilogram
cm: centimeter
BaP Eq: benzo(a)pyrene equivalent
cPAH: carcinogenic polycyclic aromatic hydrocarbon
DDx: dichlorodiphenyldichloroethane + dichlorodiphenyldichloroethene + dichlorodiphenyltrichloroethane
FS: Feasibility Study
K: elevated detection limit due to ion abundance ratios outside the QC limits.
LWG: Lower Willamette Group
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
PeCDD: 1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF: 2,3,4,7,8-pentachlorodibenzofuran
RA: Risk Assessment
ROD: Record of Decision
SMA: sediment management area
TCDD: 2,3,7,8-tetrachlorodibenzo-p-dioxin
TEQ: toxic equivalents quotient
USEPA: U.S. Environmental Protection Agency

Table 2-6
Evaluation of Unbounded Cores within the T4 Sediment Decision Unit

Location	Chemical	Within ROD SMA?	Station ID	Description	Data Gap for SMA Delineation?	Proposed Sampling to Address Data Gap
Wheeler Bay	Total PAHs and PCBs	Yes	HC-S-42	PAHs exceeded the RAL in the 0- to 2-foot and 2- to 3-foot sample intervals; no deeper samples are available at this location. No subsurface PCB results are available from this station.	Yes	Four cores to delineate the depth of PAH RAL exceedances of further investigate the extent of subsurface PCB contamination
	Total PCBs	No	VC-20	PCBs exceeded the RAL in samples between 5 and 13 feet below the mudline. Surface sediment and subsurface samples from 1- to 3-foot and 3- to 5-foot intervals did not exceed any RALs. Areas of buried contamination such as this one will be further evaluated as part of the BODR in consideration of their physical and chemical stability.	No	N/A
	Total PCBs	No	VC-21	PCBs exceeded the RAL in samples between 3 and 13 feet below the mudline; however, the top 3 feet of sediment did not exceed any RALs. Areas of buried contamination such as this one will be further evaluated as part of the BODR in consideration of their physical and chemical stability.	No	N/A
Slip 3	Total PAHs	Yes	HC-S-07	PAHs exceeded the RAL in the 0- to 2-foot and 2- to 4-foot sample intervals. Though no deeper samples are available at this location, samples from adjacent Station T4-VC-29 (located 82 feet away) help to bound PAH impacts at 6 feet (e.g., samples from 5 to 11 feet were all below the RAL). In addition, samples from station S302 (99 feet away) bound PAH impacts at 6 feet (e.g., samples from 6 to 7 feet, 7 to 8 feet, and beyond are below the RAL).	Yes	Four cores at head of Slip 3 to delineate the depth of PAH and PCB RAL exceedances
	Total PAHs	Yes	B41106	PAHs exceeded the RAL in the 7- to 8-foot and 9- to 10-foot sample intervals; no deeper (or shallower) samples are available at this location.[1]	Yes	
	Total PCBs	Yes		PCBs exceeded the RAL in the 7- to 8-foot, 8- to 9-foot, and 9- to 10-foot sample intervals; no deeper (or shallower) samples are available at this location.[1]	Yes	
	DDx	Yes	VC-29	Though not an unbounded core, a historical DDx RAL exceedance was identified in the 1- to 3-foot sample interval at this station. Samples from the 3- to 5-foot and 5- to 7-foot intervals and beyond are below the RAL.	Yes	DDx testing at two of the above proposed cores at the head of Slip 3 that are closest to this historical DDx RAL exceedance
	Total PAHs	Yes	SD031	PAHs exceeded the RAL in the 0- to 3-foot sample interval. Though no deeper samples are available at this location, samples from adjacent Station S305 (21 feet away) at the 8- to 9-foot and 9- to 10-foot depth intervals had PAH levels below the RAL and thereby help to bound the vertical extent of PAHs in this vicinity.	No	N/A
	Total PAHs	Yes	HC-S-27	PAHs exceeded the RAL in the 0- to 2-foot and 2- to 4-foot sample intervals. Though no deeper samples are available at this location, samples from adjacent Station S307 (46 feet away) help to bound PAH impacts at 4 feet (e.g., samples from 4 to 5 feet and 5 to 6 feet are below the RAL).	No	N/A
	Total PAHs	Yes	HC-S-11	PAHs exceeded the RAL in the 0- to 2-foot and 2- to 4-foot sample intervals. Though no deeper samples are available at this location, samples from adjacent Station S302 (41 feet away) help to bound PAH impacts at 6 feet (e.g., samples from 6 to 7 feet, 7 to 8 feet, and beyond are below the RAL).	No	N/A
Upstream of Slip 3	Total DDx	No	PI-09	DDx exceeded the RAL in the 1- to 2-foot sample interval; no deeper samples are available at this location. Surface interval is below the RAL for DDx.	Yes	One core at this location to delineate the depth of DDx RAL exceedance

Notes:
1. Existing subsurface Station B41106 was part of a sheetpile wall study that included focused sampling at depth; the shallower sample intervals were never sampled, and this area has not been dredged. The mudline at the time of sampling was -33 feet NAVD88, so these impacts are at approximately -40 to -43 feet NAVD88.

BODR: Basis of Design Report
DDx: dichlorodiphenyldichloroethane + dichlorodiphenyldichloroethene + dichlorodiphenyltrichloroethane
N/A: not applicable
NAVD88: North American Vertical Datum of 1988
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
RAL: remedial action level
SMA: sediment management area
T4: Terminal 4

Figures

LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.

0 250
Feet

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Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig1-1_SiteLocation.mxd

ANCHOR QEA

Figure 1-1
Site Location
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy

LEGEND:

Sediment Decision Unit RM 4.5E
Navigation Channel
Shoreline Structures

SMA Technology Assignments, Selected Remedy

Cap
Dredge
Dredge in Nav-FMD
Dredge with Cap

NOTES:
1. SMA technology assignment from the USEPA Record of Decision 2017.
2. Nav-FMD = navigation and future maintenance dredge areas
3. Arrow indicates direction of flow of river.
4. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
5. Aerial imagery from City of Portland 2016.
6. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

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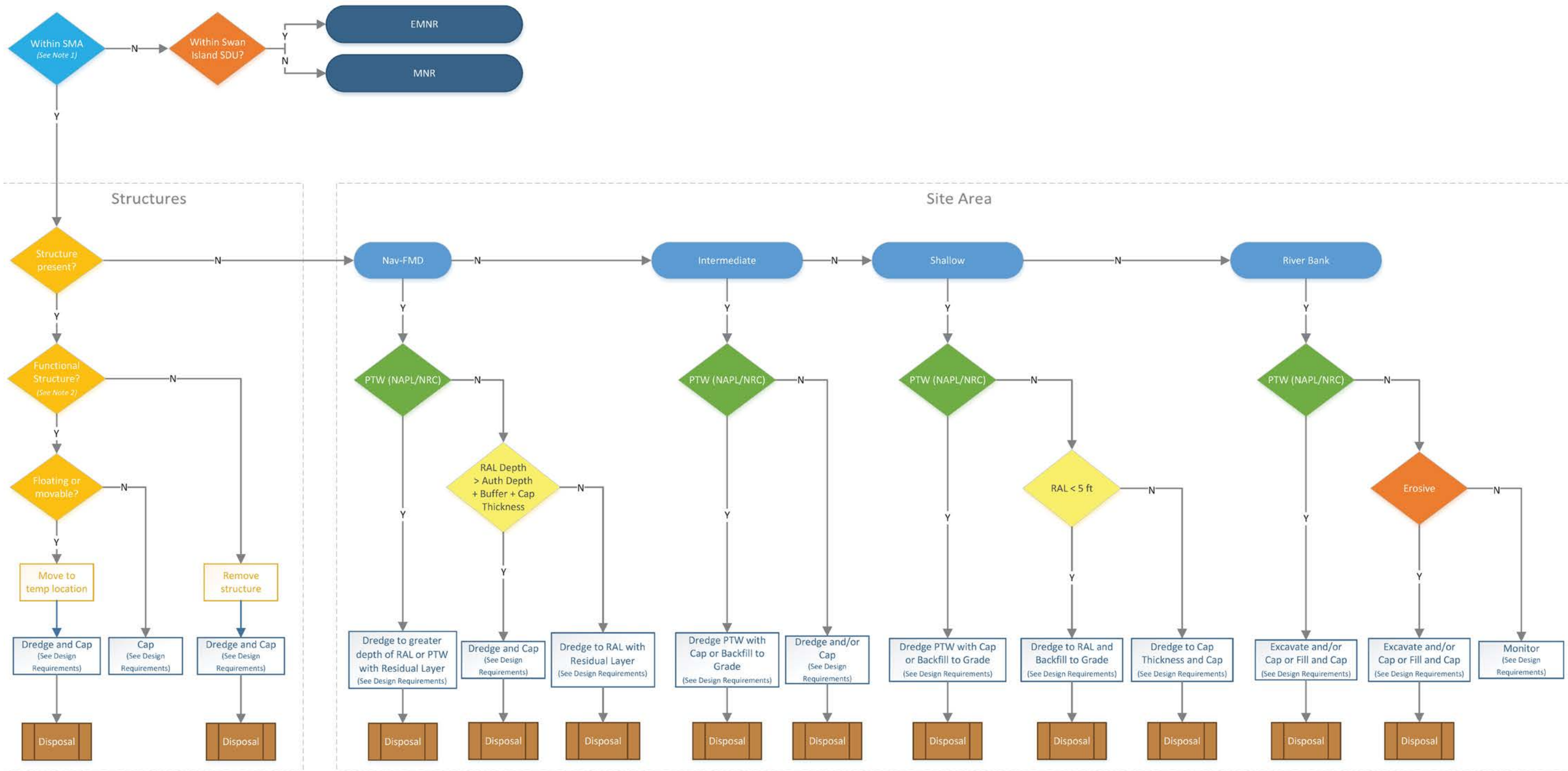
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig1-2_T4SedManagementAreas.mxd

ANCHOR QEA

Figure 1-2
Preliminary ROD Sediment Management Areas
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



Notes:
(1) Contamination is defined in three dimensions.
(2) Currently operating or used to stabilize bank. Service life > 50 yrs.

Source: Figure 28 Technology Application Decision Tree from the Portland Harbor Record of Decision (USEPA 2017b)

Filepath: \\fuji\anchor\Projects\Port of Portland\CONFIDENTIAL_T4\Post-ROD Support\Deliverables\PDI Work Plan\02- Figures_Reference\Source Files for Figs 1-3 and 3-4\Figure 1-3_Tech App Decision Tree_2018-12-28.docx

LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- Terminal 4 Early Action Dredging (2008)
- Berth 401 Dredging (2015)
- Berth 410 Dredging (2016)
- Potential Maintenance Dredging
- ROD SMAs (USEPA 2017)
- Berths 401 and 410 Surface Samples
- Surface Sediment Locations

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. Surface sediment locations are from the USEPA FS Database.
5. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
6. Berth 410 and Berth 401 surface samples are not included in the USEPA FS Database.
6. Sample intervals dredged during 2008 early action remediation were removed from analyses.
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

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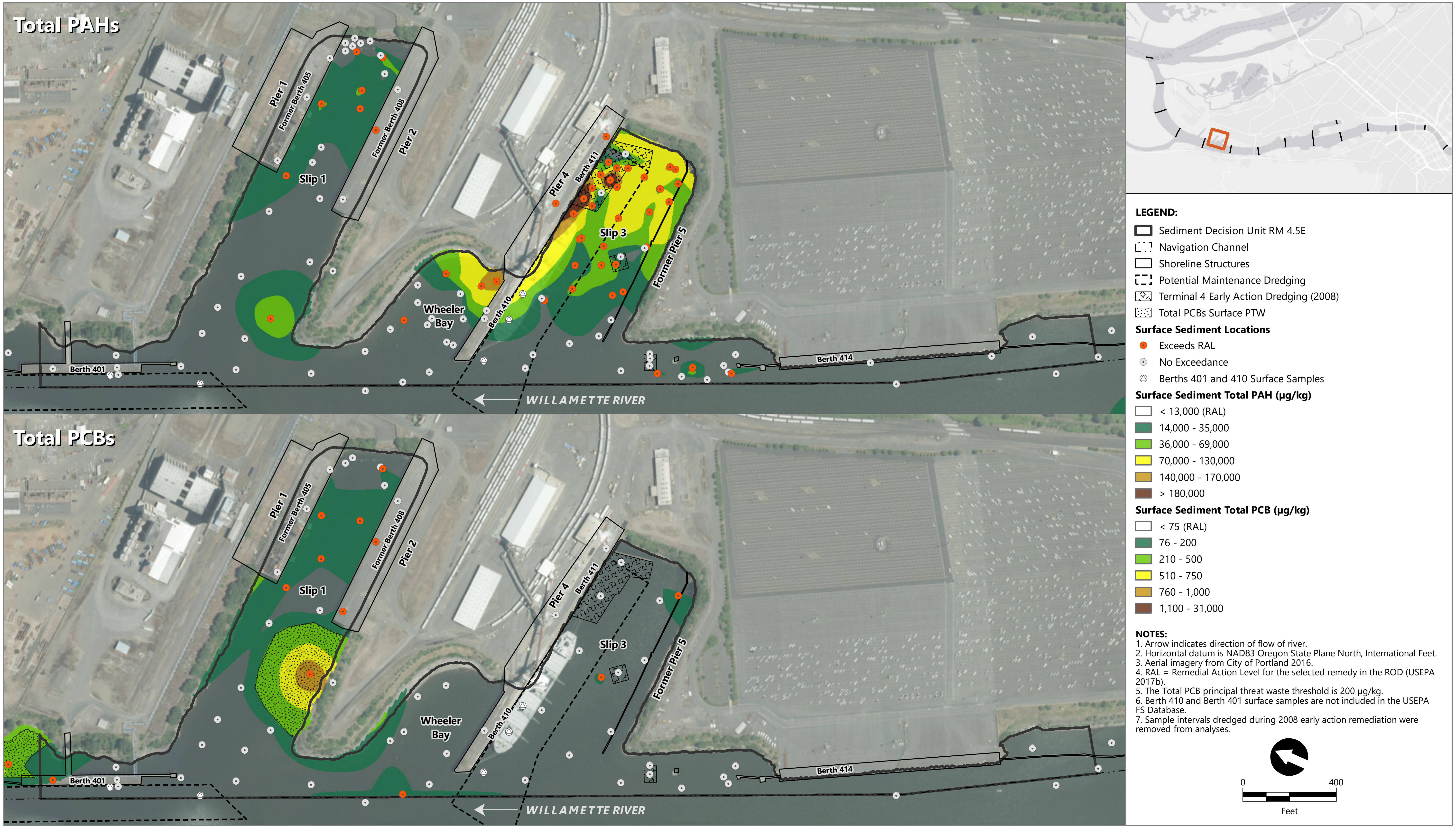
ANCHOR QEA

Figure 2-1
Existing Surface Sediment Samples
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



NOTES:
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. RAL = Remedial Action Level for the selected remedy in the ROD (USEPA 2017b).
5. The Total PCB principal threat waste threshold is 200 µg/kg.
6. Berth 410 and Berth 401 surface samples are not included in the USEPA FS Database.
7. Sample intervals dredged during 2008 early action remediation were removed from analyses.

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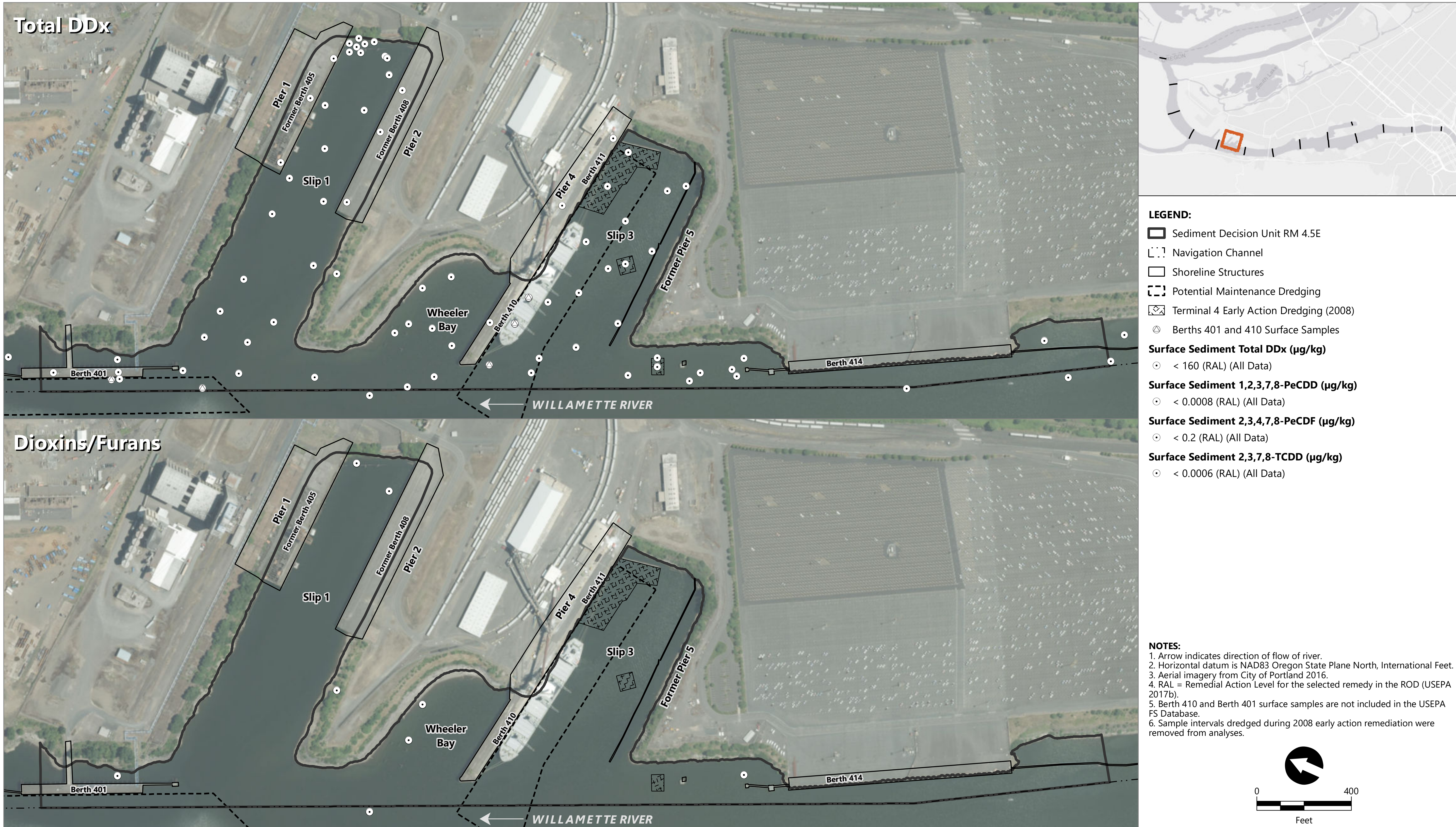
ANCHOR QEA

Figure 2-2
Surface Sediment Concentrations – Total PAHs and Total PCBs
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



NOTES:
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. RAL = Remedial Action Level for the selected remedy in the ROD (USEPA 2017b).
5. Berth 410 and Berth 401 surface samples are not included in the USEPA FS Database.
6. Sample intervals dredged during 2008 early action remediation were removed from analyses.

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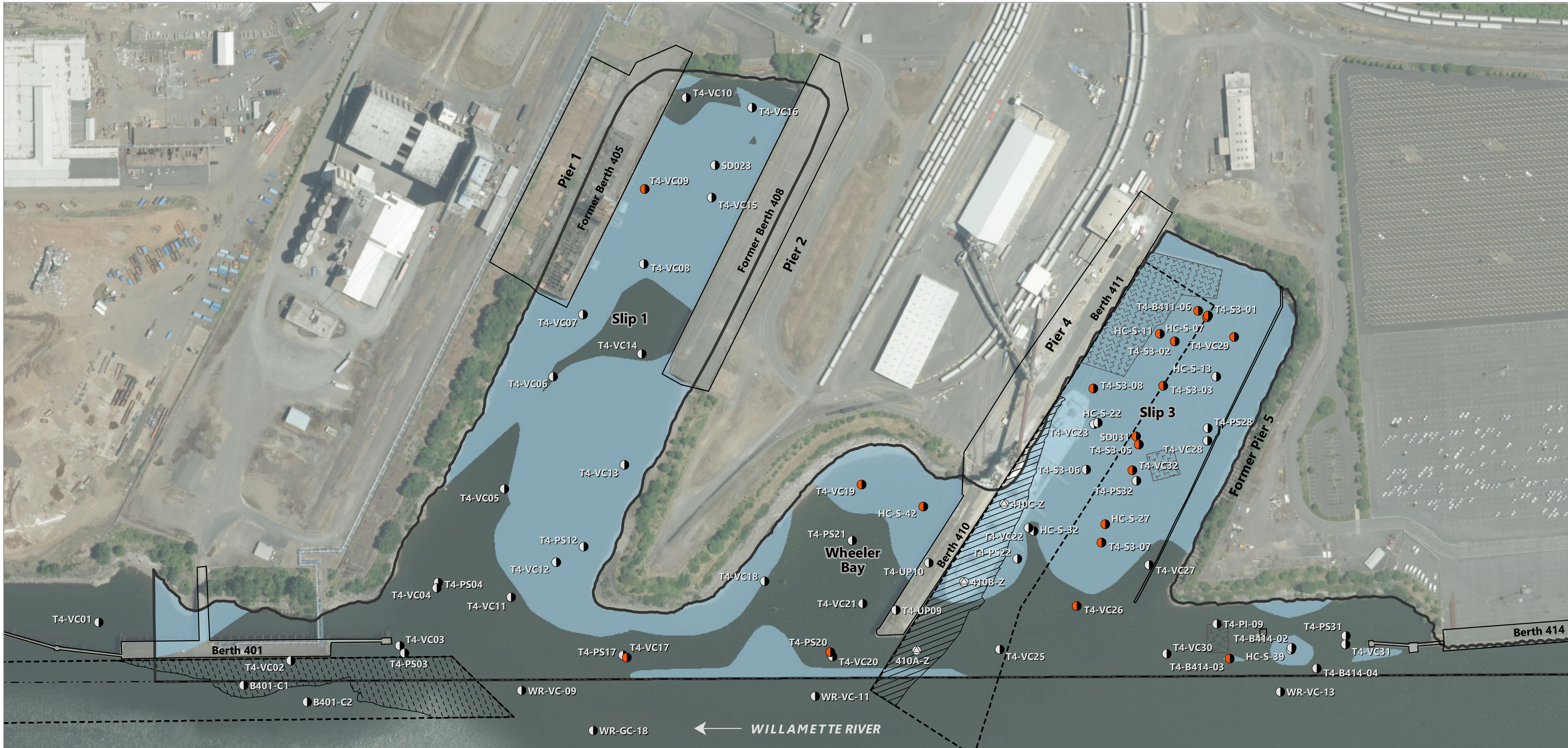
ANCHOR QEA

Figure 2-3
Surface Sediment Concentrations – Total DDx and Dioxins/Furans
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- ROD SMAs (USEPA 2017)
- Berth 401 Dredging (2015)
- Berth 410 Dredging (2016)
- Terminal 4 Early Action Dredging (2008)
- Potential Maintenance Dredging
- Berth 410 Subsurface Samples

Total PAH Exceedances

- Subsurface Sediment, Exceeds RAL
- Subsurface Sediment, No Exceedance

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Berth 410 subsurface samples are not included in the USEPA FS Database.
6. Sample intervals dredged during 2008 early action remediation were removed from analyses.
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

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Feet

Publish Date: 2018/12/26, 1:10 PM | User: joliver
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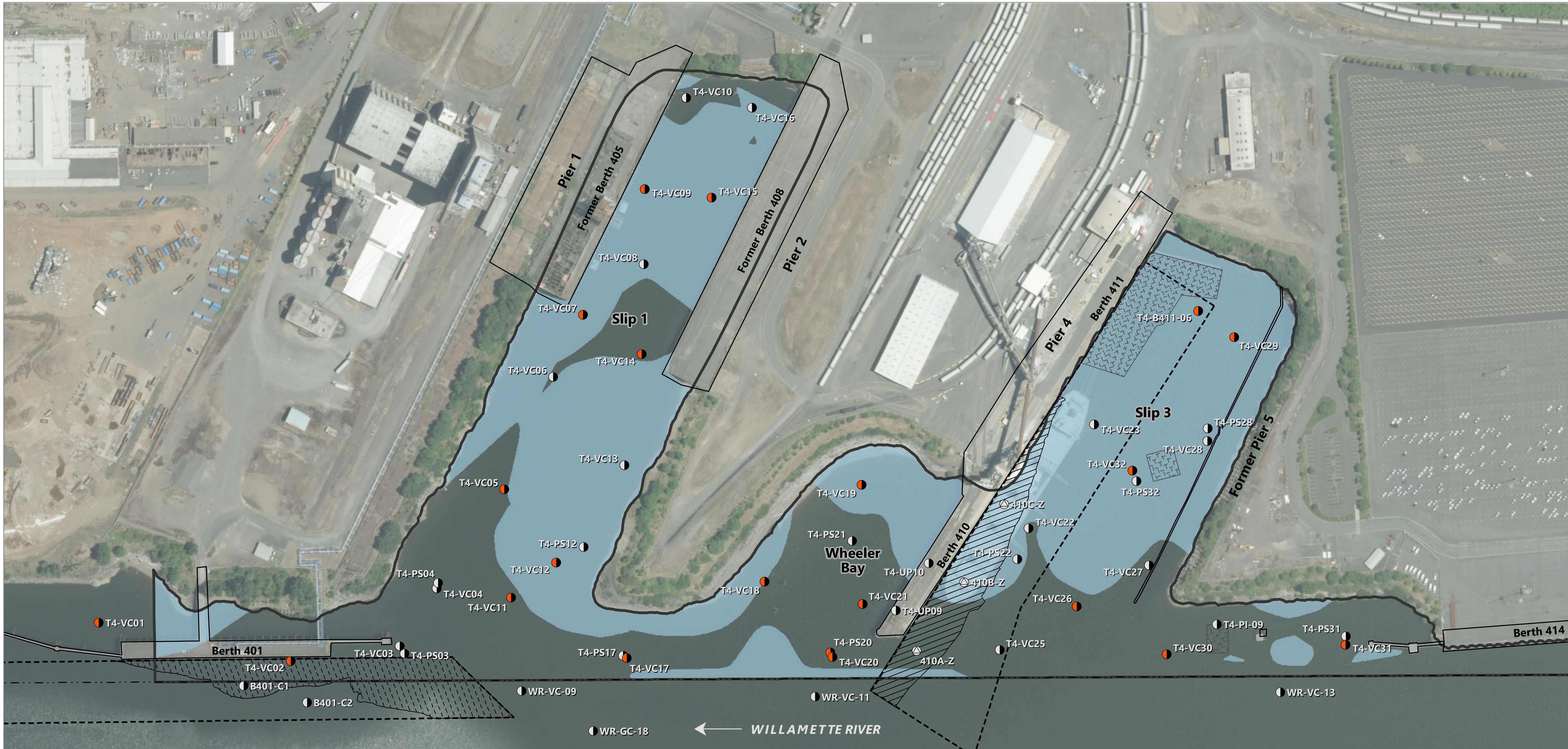
ANCHOR QEA

Figure 2-4
Subsurface Sediment Data – Total PAHs
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

Sediment Decision Unit RM 4.5E
Navigation Channel
Shoreline Structures
ROD SMAs (USEPA 2017)
Berth 401 Dredging (2015)
Berth 410 Dredging (2016)
Terminal 4 Early Action Dredging (2008)
Potential Maintenance Dredging
Berth 410 Subsurface Samples

Total PCB Exceedances

Subsurface Sediment, Exceeds RAL
Subsurface Sediment, No Exceedance

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Berth 410 subsurface samples are not included in the USEPA FS Database.
6. Sample intervals dredged during 2008 early action remediation were removed from analyses.
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

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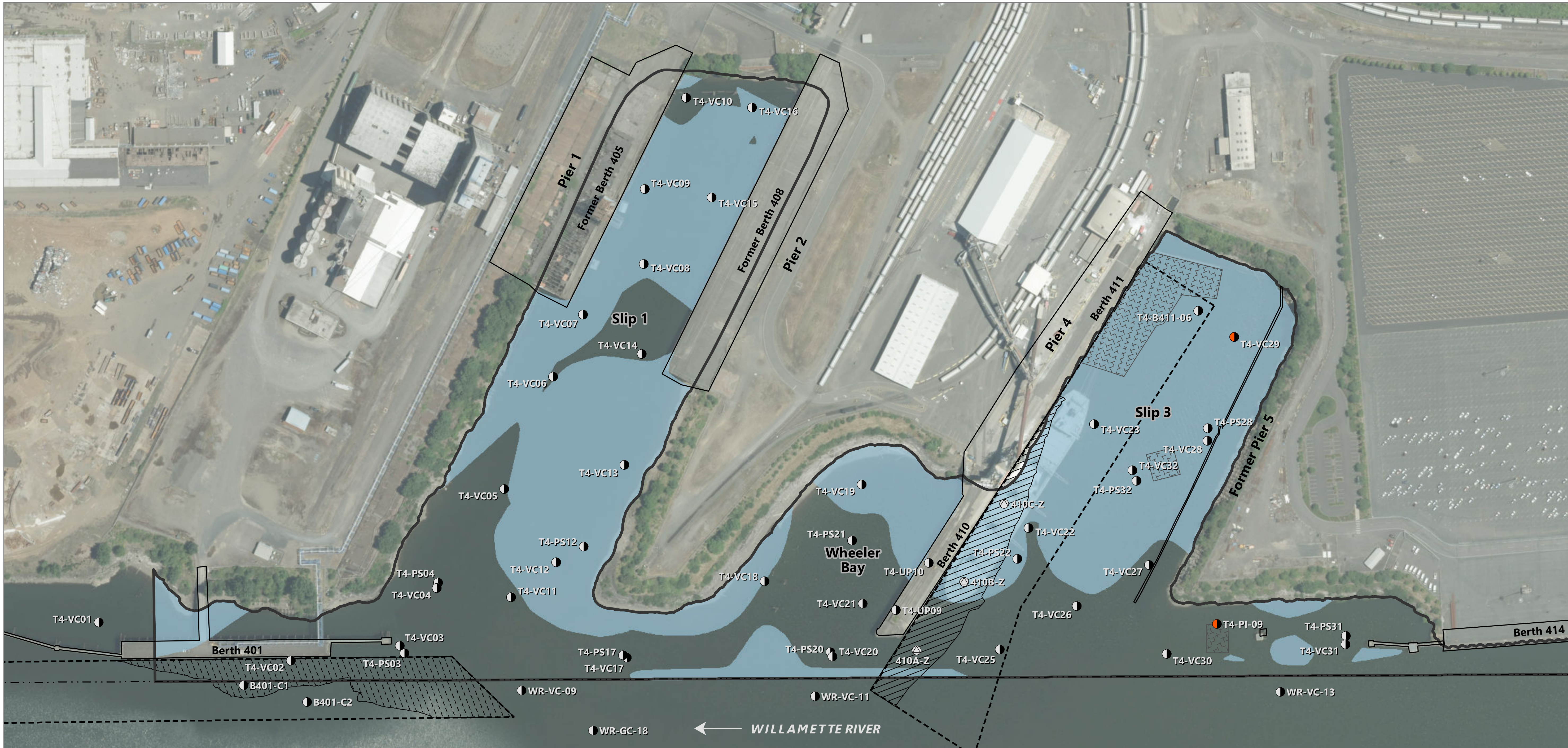
ANCHOR QEA

Figure 2-5
Subsurface Sediment Data – Total PCBs
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- ROD SMAs (USEPA 2017)
- Berth 401 Dredging (2015)
- Berth 410 Dredging (2016)
- Terminal 4 Early Action Dredging (2008)
- Potential Maintenance Dredging
- Berth 410 Subsurface Samples

Total DDx Exceedances

- Subsurface Sediment, Exceeds RAL
- Subsurface Sediment, No Exceedance

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Berth 410 subsurface samples are not included in the USEPA FS Database.
6. Sample intervals dredged during 2008 early action remediation were removed from analyses.
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

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Feet

Publish Date: 2018/12/26, 1:11 PM | User: joliver
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig2-6_SubsurfaceDDx.mxd

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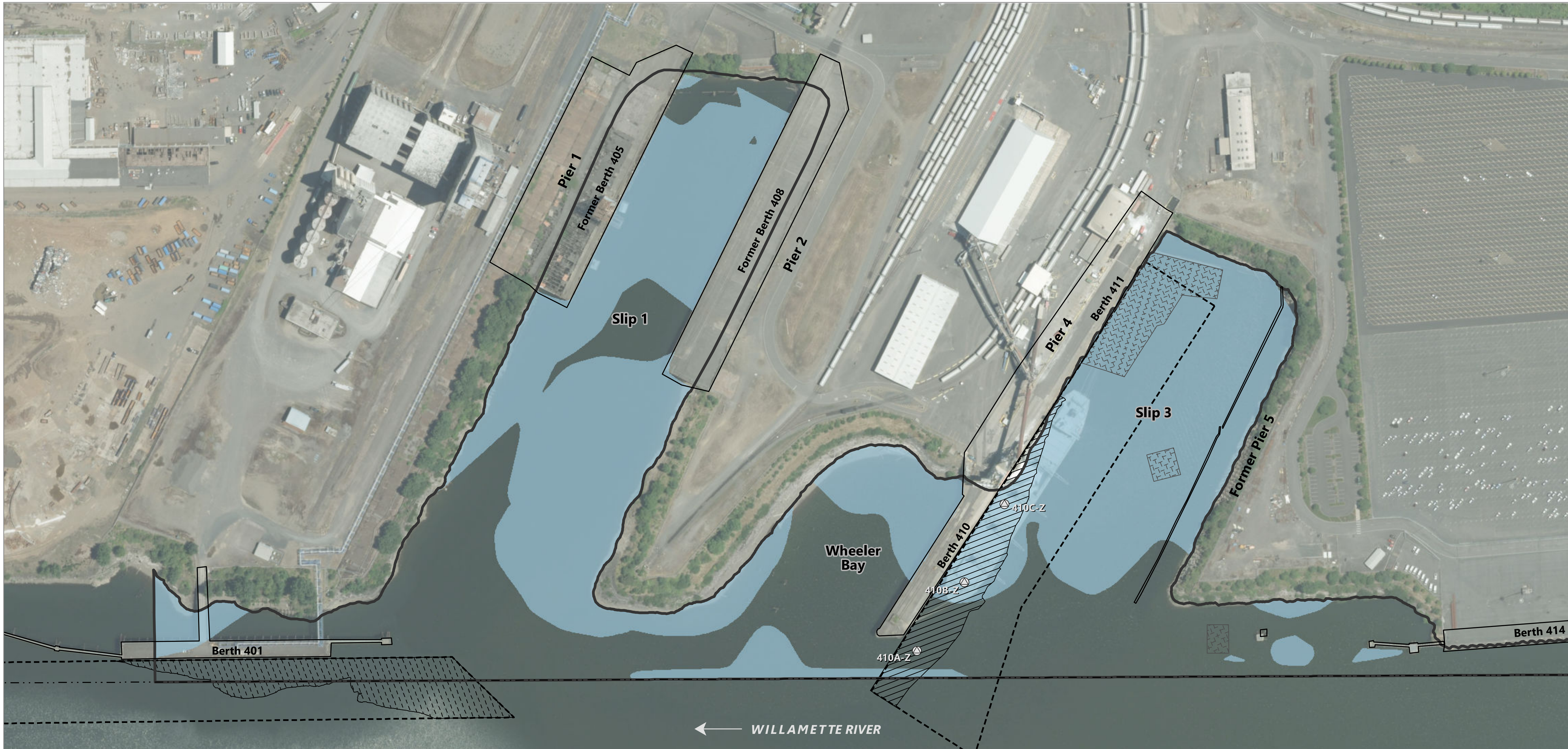
Figure 2-6
Subsurface Sediment Data – Total DDx
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- ROD SMAs (USEPA 2017)
- Berth 401 Dredging (2015)
- Berth 410 Dredging (2016)
- Terminal 4 Early Action Dredging (2008)
- Potential Maintenance Dredging
- Berth 410 Subsurface Samples

Dioxin/Furans Exceedances

- Subsurface Sediment, Exceeds RAL
- Subsurface Sediment, No Exceedance

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Berth 410 subsurface samples are not included in the USEPA FS Database.
6. Sample intervals dredged during 2008 early action remediation were removed from analyses.
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

0 250
Feet

Publish Date: 2018/12/26, 1:11 PM | User: joliver
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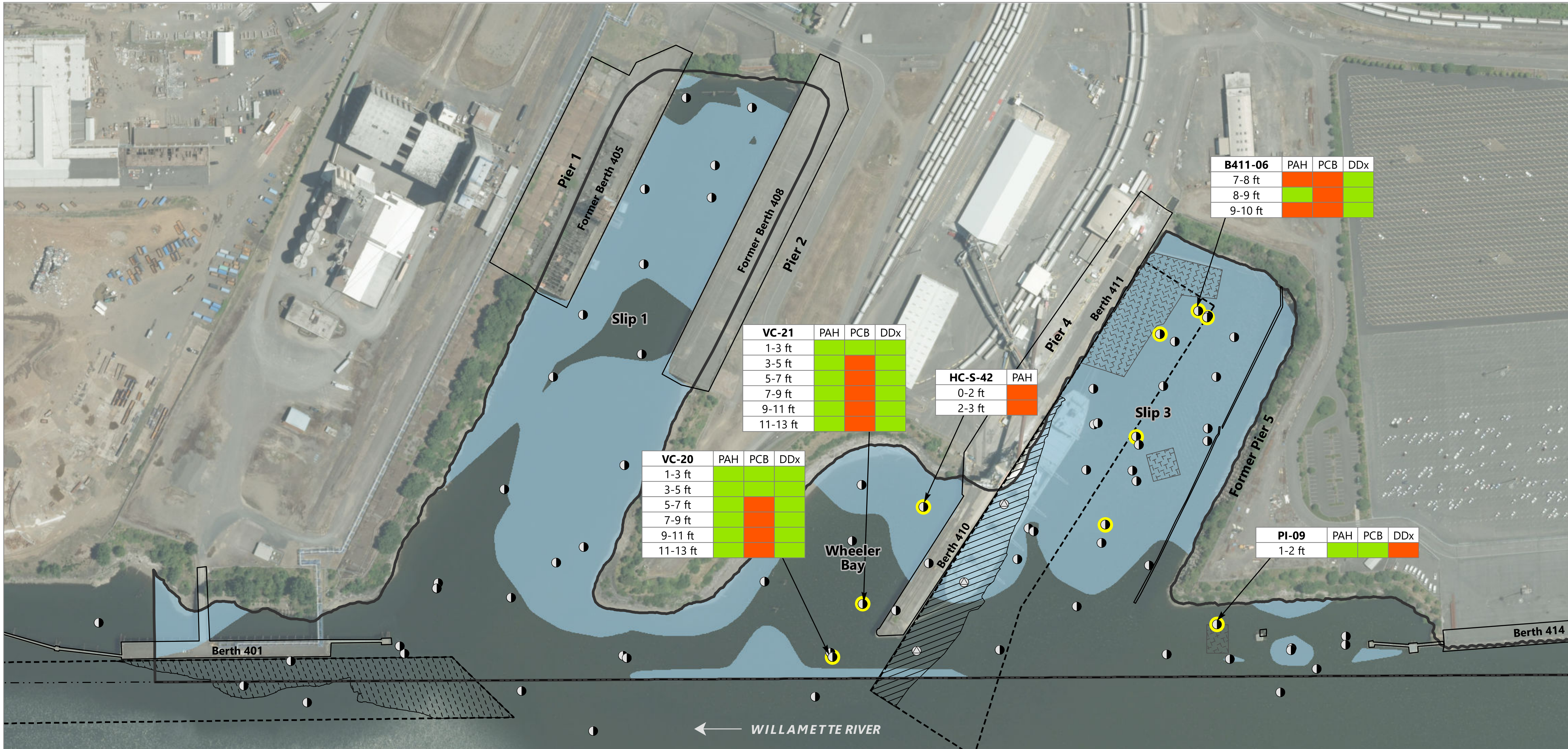
ANCHOR QEA

Figure 2-7
Subsurface Sediment Data – Dioxins/Furans
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- ROD SMAs (USEPA 2017)
- Berth 401 Dredging (2015)
- Berth 410 Dredging (2016)
- Terminal 4 Early Action Dredging (2008)
- Potential Maintenance Dredging
- Subsurface Sediment Locations
- Berth 410 Subsurface Samples
- Vertical Extent Not Defined

Core ID → PI-09 | PAH | PCB | DDx
Depth Interval → 1-2 ft
Does Not Exceed RAL
Exceeds RAL

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Berth 410 subsurface samples are not included in the USEPA FS Database.
6. Sample intervals dredged during 2008 early action remediation were removed from analyses.
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

0 250
Feet

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Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig2-8_UnboundedSubsurface.mxd

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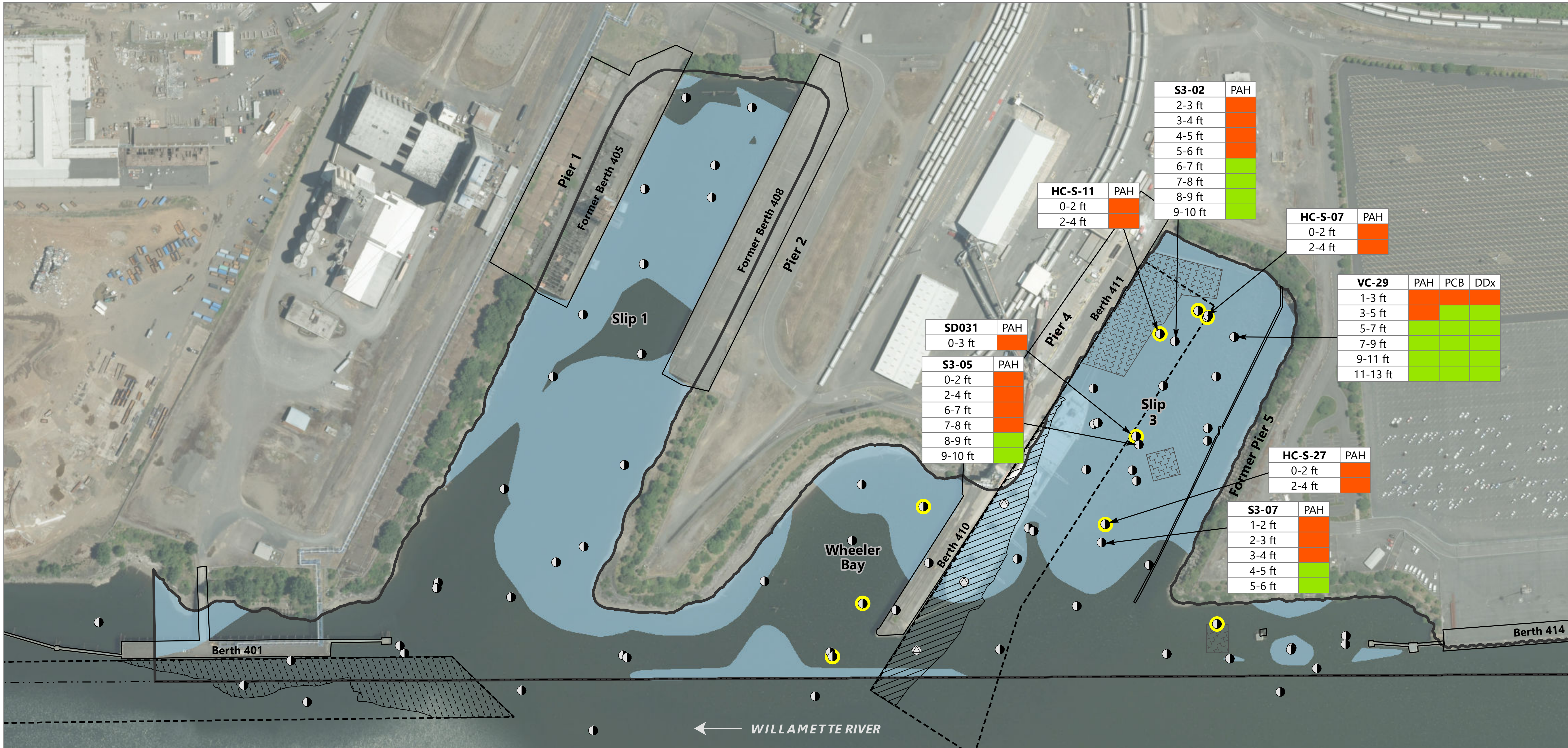
Figure 2-8
Existing Unbounded Subsurface Locations
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- ROD SMAs (USEPA 2017)
- Berth 401 Dredging (2015)
- Berth 410 Dredging (2016)
- Terminal 4 Early Action Dredging (2008)
- Potential Maintenance Dredging
- Subsurface Sediment Locations
- Berth 410 Subsurface Samples
- Vertical Extent Not Defined

Core ID → VC-29 | PAH | PCB | DDx
Depth Interval → 3-5 ft
Exceeds RAL
Does Not Exceed RAL

NOTES:

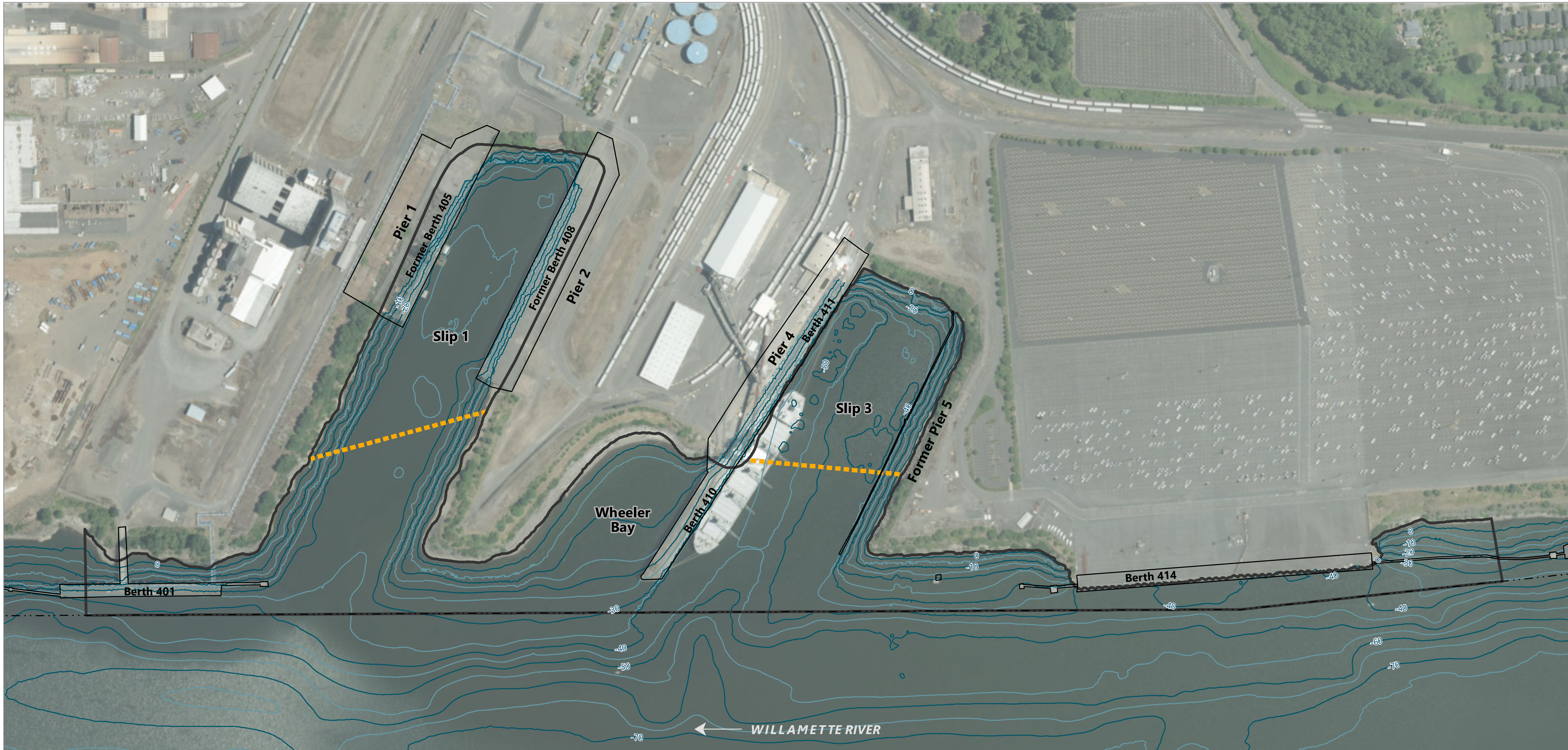
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Berth 410 subsurface samples are not included in the USEPA FS Database.
6. Sample intervals dredged during 2008 early action remediation were removed from analyses.
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

0 250
Feet

Publish Date: 2018/12/26, 1:12 PM | User: joliver
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig2-9_SubsurfaceBoundedNearby.mxd

ANCHOR QEA

Figure 2-9
Subsurface Locations Bounded by Nearby Cores
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- Sediment Decision Unit RM 4.5E
- Approximate DSL Property Boundary
- Bathymetric Contour 2009 (feet CRD)

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. DSL = Oregon Department of State Lands
5. CRD = Columbia River Datum

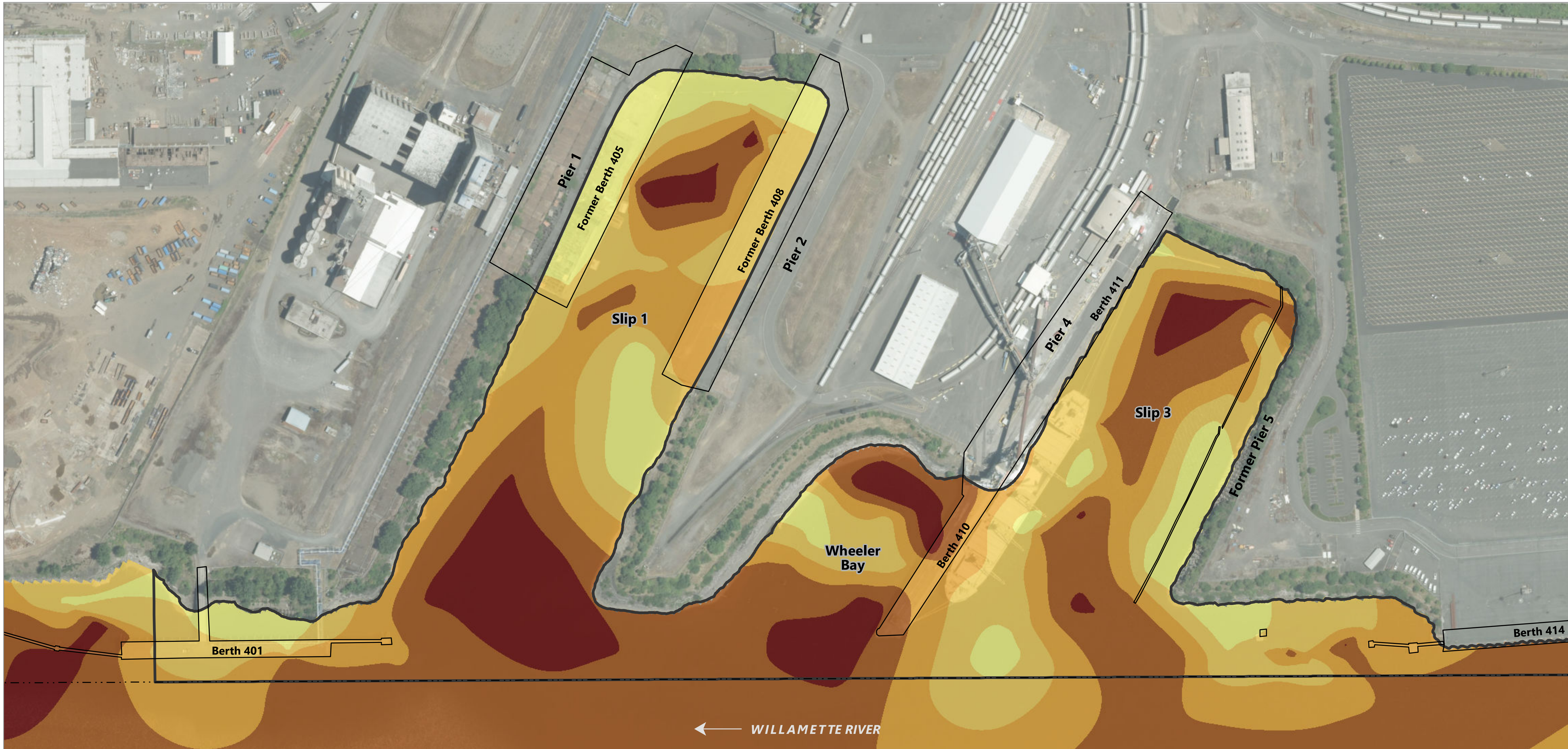
0 250
Feet

Publish Date: 2018/12/26, 1:13 PM | User: joliver
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig3-1_T4Overview.mxd

ANCHOR QEA

Figure 3-1
Terminal 4 Overview

Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

Sediment Decision Unit RM 4.5E
Navigation Channel
Shoreline Structures
Potential Maintenance Dredging

Percent Fines

0 - 20%
20 - 40%
40 - 60%
60 - 80%
80 - 100%

NOTES:

1. Percent fines from USEPA Feasibility Study, 2016, Figure 2.2-1.
2. Arrow indicates direction of flow of river.
3. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
4. Aerial imagery from City of Portland 2016.
5. SDU boundary extends approximately 1,000 feet upstream from the extent shown.

0 250
Feet

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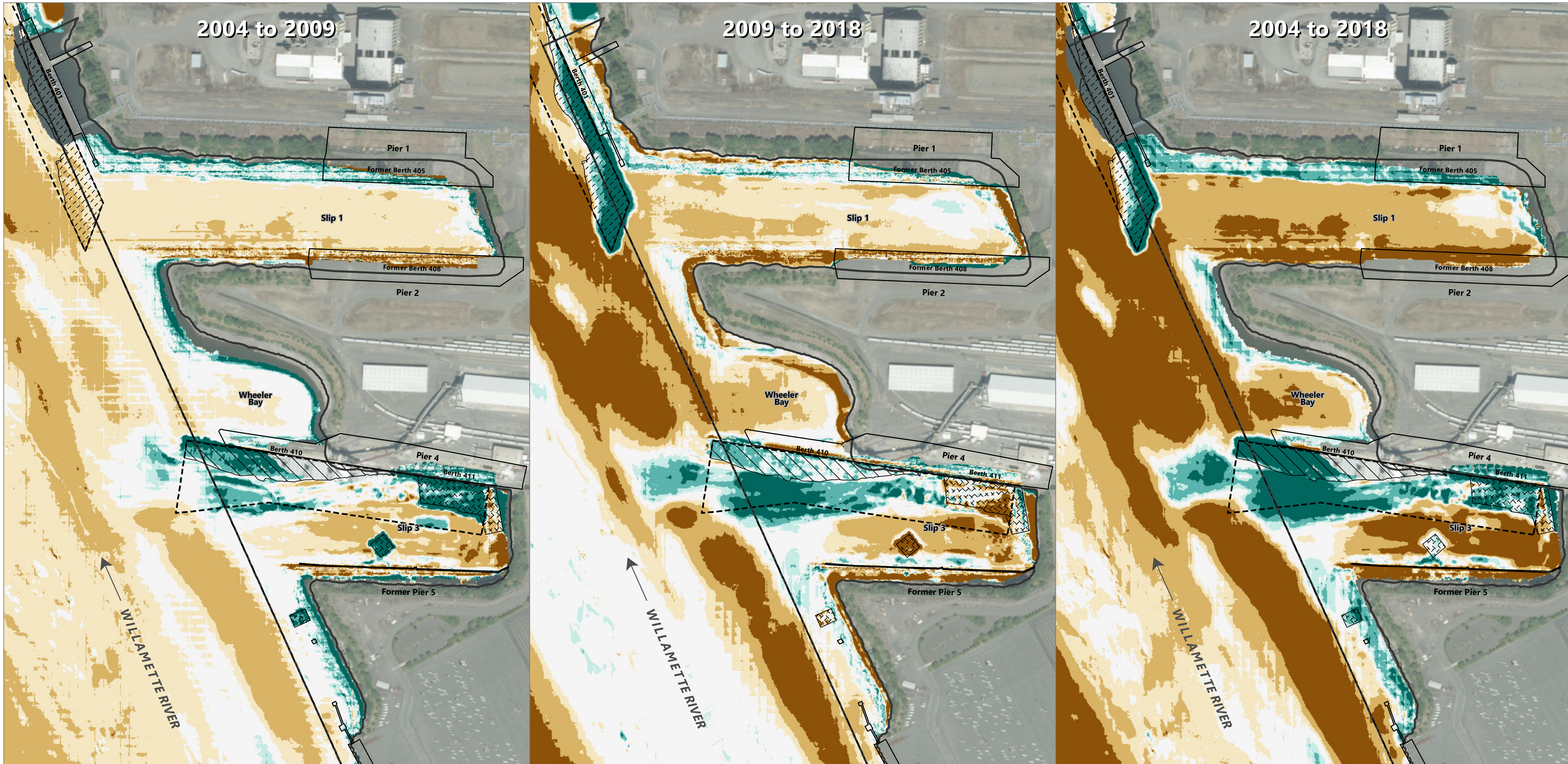
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig3-2_PercentFines.mxd

ANCHOR QEA

Figure 3-2
Percent Fines Distribution in Surface Sediments
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

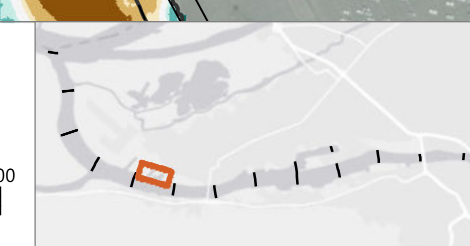
- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- Berth 401 Dredging (2015)
- Berth 410 Dredging (2016)
- Terminal 4 Early Action Dredging (2008)
- Potential Maintenance Dredging

Bathymetric Change (feet)

- < -2
- -1.99 - -1
- -0.99 - -0.5
- -0.49 - 0.5
- 0.51 - 1
- 1.01 - 2
- > 2

NOTES:
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Bathymetric surveys performed by David Evans and Associates.
6. Bathymetry for 2004 and 2009 has a 1-meter resolution. Bathymetry for 2018 has a 3-foot resolution.

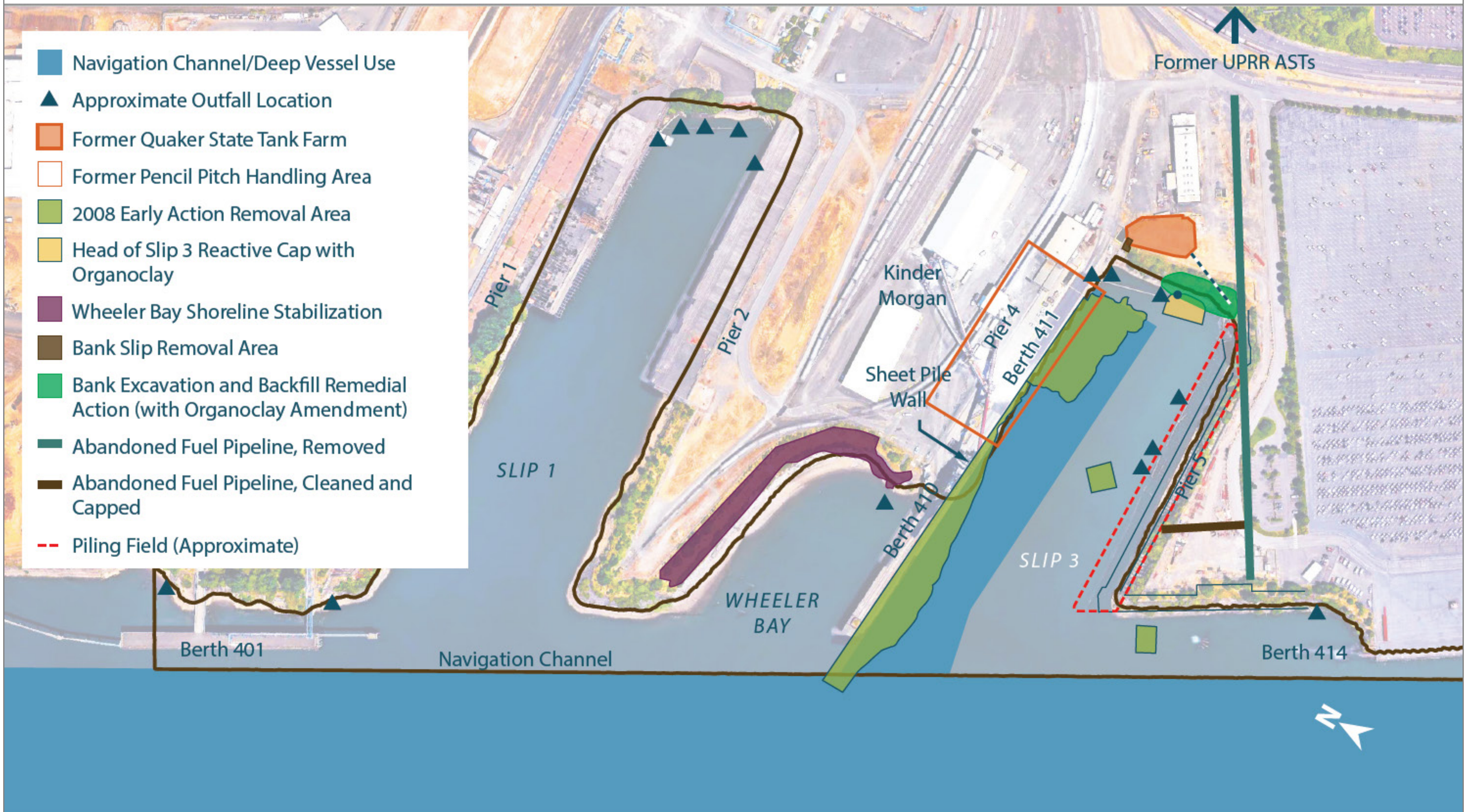
0 400
Feet



Publish Date: 2018/12/26, 1:13 PM | User: joliver
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig3-3_BathymetryChanges_3panel.mxd

ANCHOR QEA

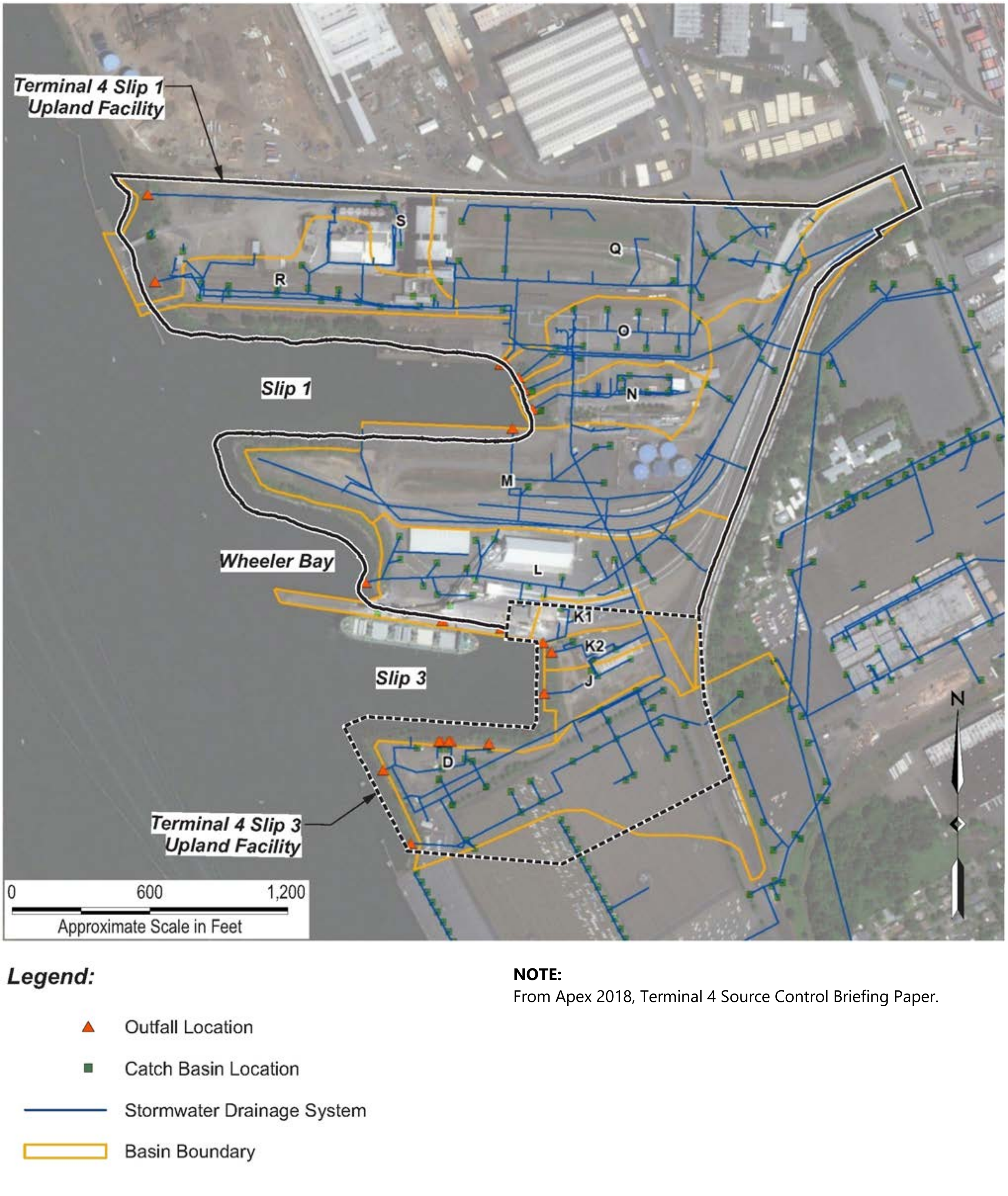
Figure 3-3
Net Bathymetric Change
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



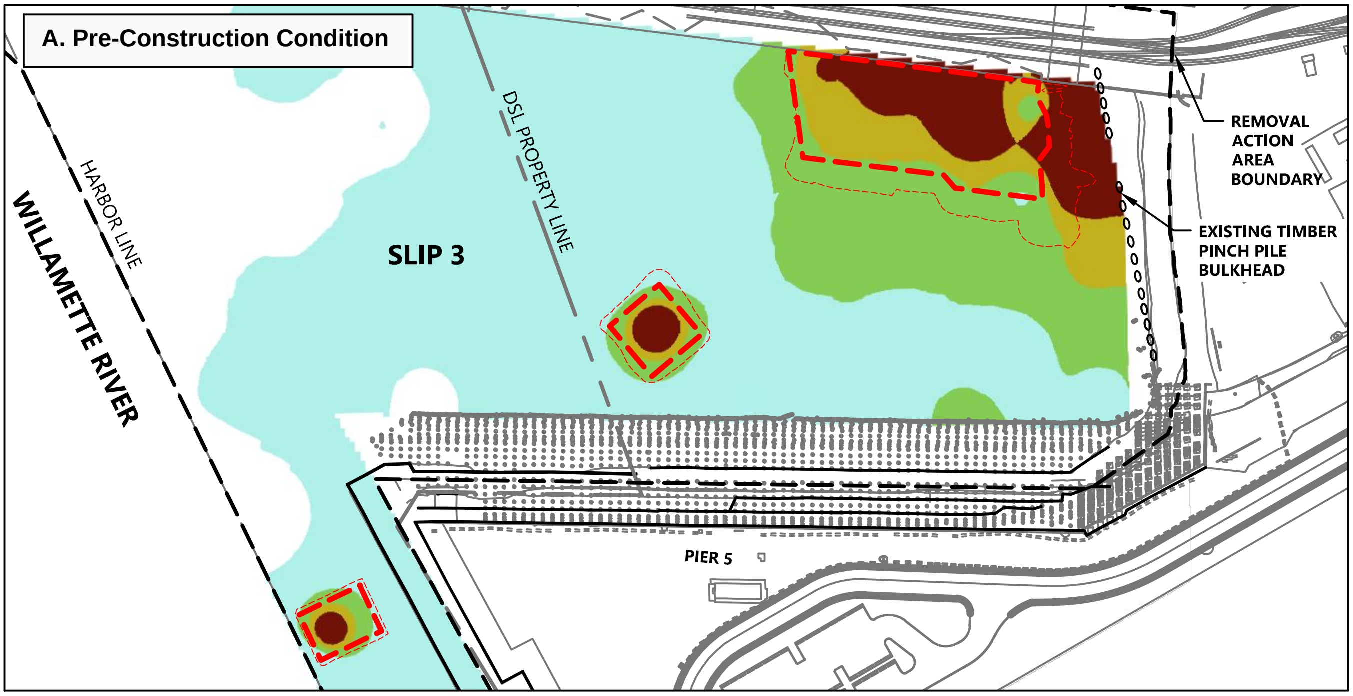
Filepath: \\fuji\anchor\Projects\Port of Portland\CONFIDENTIAL_T4\Post-ROD Support\Deliverables\PDI Work Plan\02- Figures_Reference\Source Files for Figs 1-3 and 3-4\PDI Figure 3-4_2018-12-28.docx

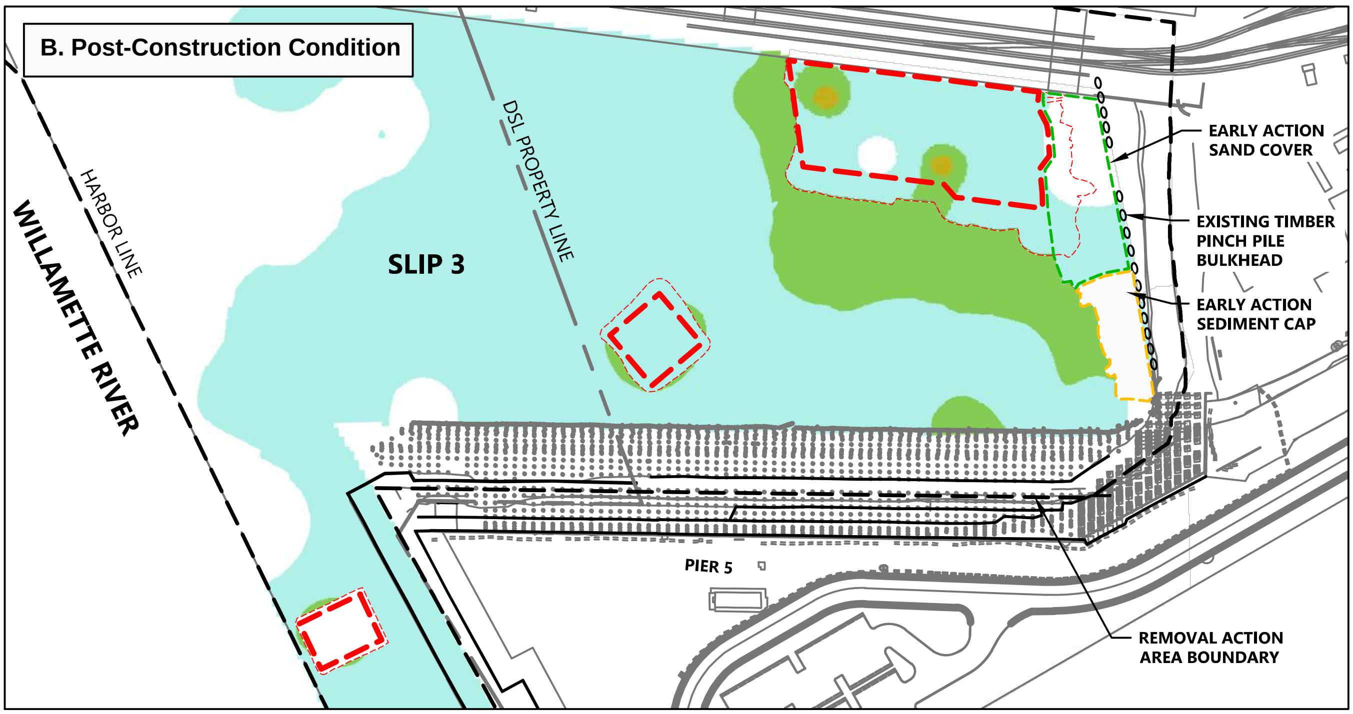
ANCHOR QEA

Figure 3-4
Previous Upland and In-Water Remedial Actions
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



NOTE:
From Apex 2018, Terminal 4 Source Control Briefing Paper.





HORIZONTAL DATUM: Port of Portland Local Projection, International Feet. **VERTICAL DATUM: NGVD29-47.**

SURFACE PROBABLE EFFECTS CONCENTRATION EXCEEDANCE RATIO:

- <1
- 1-10
- 10.1-20
- 20.1-30
- >30

EARLY ACTION COMPONENTS (PHASE I):

- PHASE I DREDGE BOUNDARY
- PHASE I DAYLIGHT BOUNDARY
- SAND COVER
- SEDIMENT CAP

0 200
Feet

Publish Date: 2018/09/05 1:43 PM | User: mpratschner
Filepath: K:\Projects\0332-Port of Portland\Portland Harbor Feasibility Study Review\0332-RP-001.dwg Figure 3-5

ANCHOR QEA

Figure 3-6
Terminal 4 Phase I Removal Action Contaminant Reduction

LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- Potential FMD Areas
- Approximate Intermediate Areas (Elevation below -2 feet CRD with limited or no future navigation requirements)
- Approximate Shallow Areas (Elevation above -2 feet CRD)

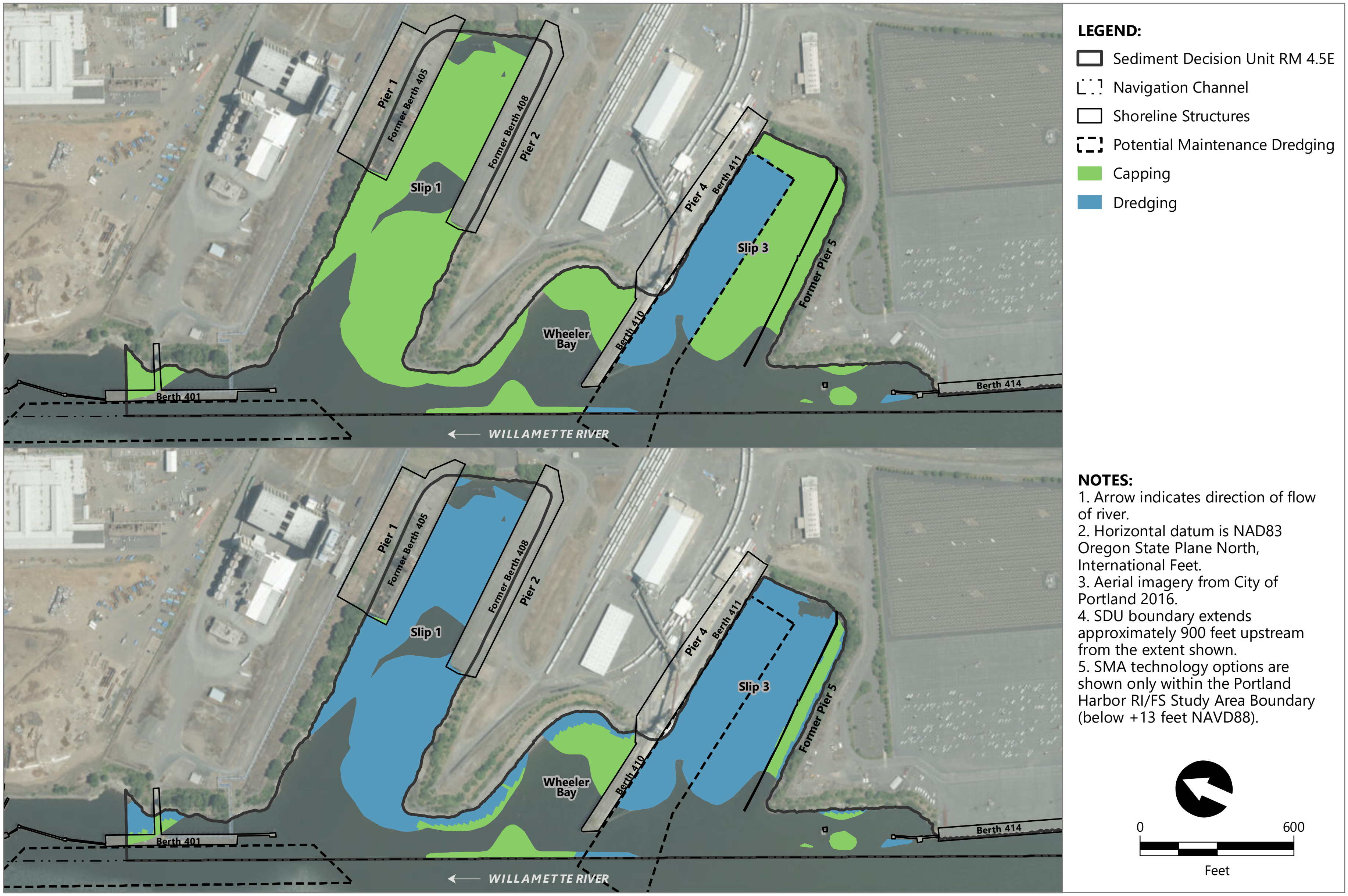
NOTES:
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. FMD = Future Maintenance Dredging
6. CRD = Columbia River Datum
7. Design requirements are from the USEPA Record of Decision 2017.

0 250
Feet

Publish Date: 2018/12/26, 1:14 PM | User: joliver
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig4-1_SiteRequirements.mxd

ANCHOR QEA

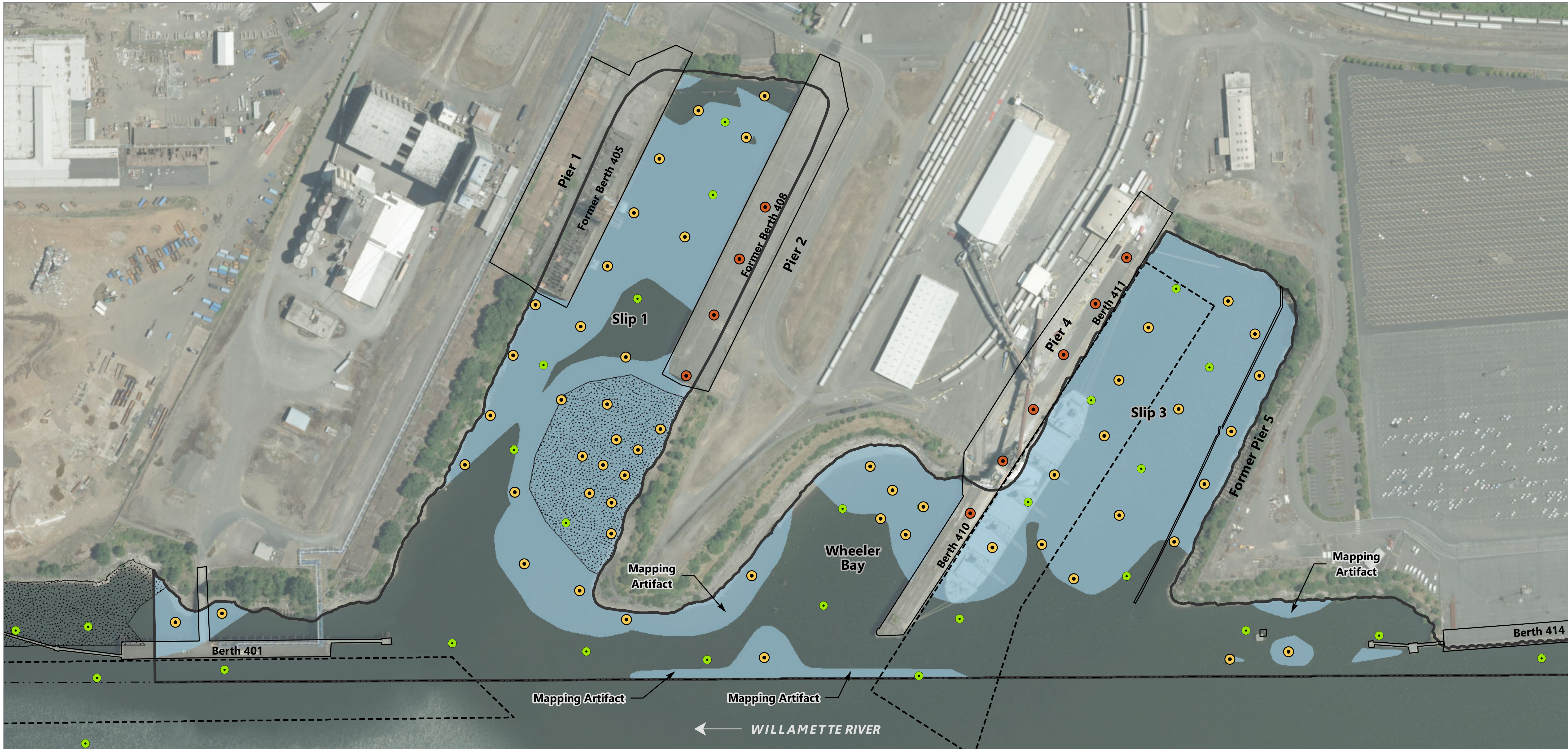
Figure 4-1
Preliminary ROD Site Design Requirements
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



Publish Date: 2018/12/26, 1:14 PM | User: joliver
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig4-2_TechOptions.mxd

ANCHOR QEA

Figure 4-2
Terminal 4 Technology Options Considering ROD Flexibility
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- Potential Maintenance Dredging
- ROD SMAs (USEPA 2017b)
- Total PCBs Surface PTW
- Pre-RD Group Surface Grab Samples

Recommended Samples

- Surface Grab Samples
- Underpier Surface Grab Samples

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

0 250

Feet

Publish Date: 2018/12/26, 1:14 PM | User: joliver

Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig5-1_ProposedSurfaceSamples.mxd

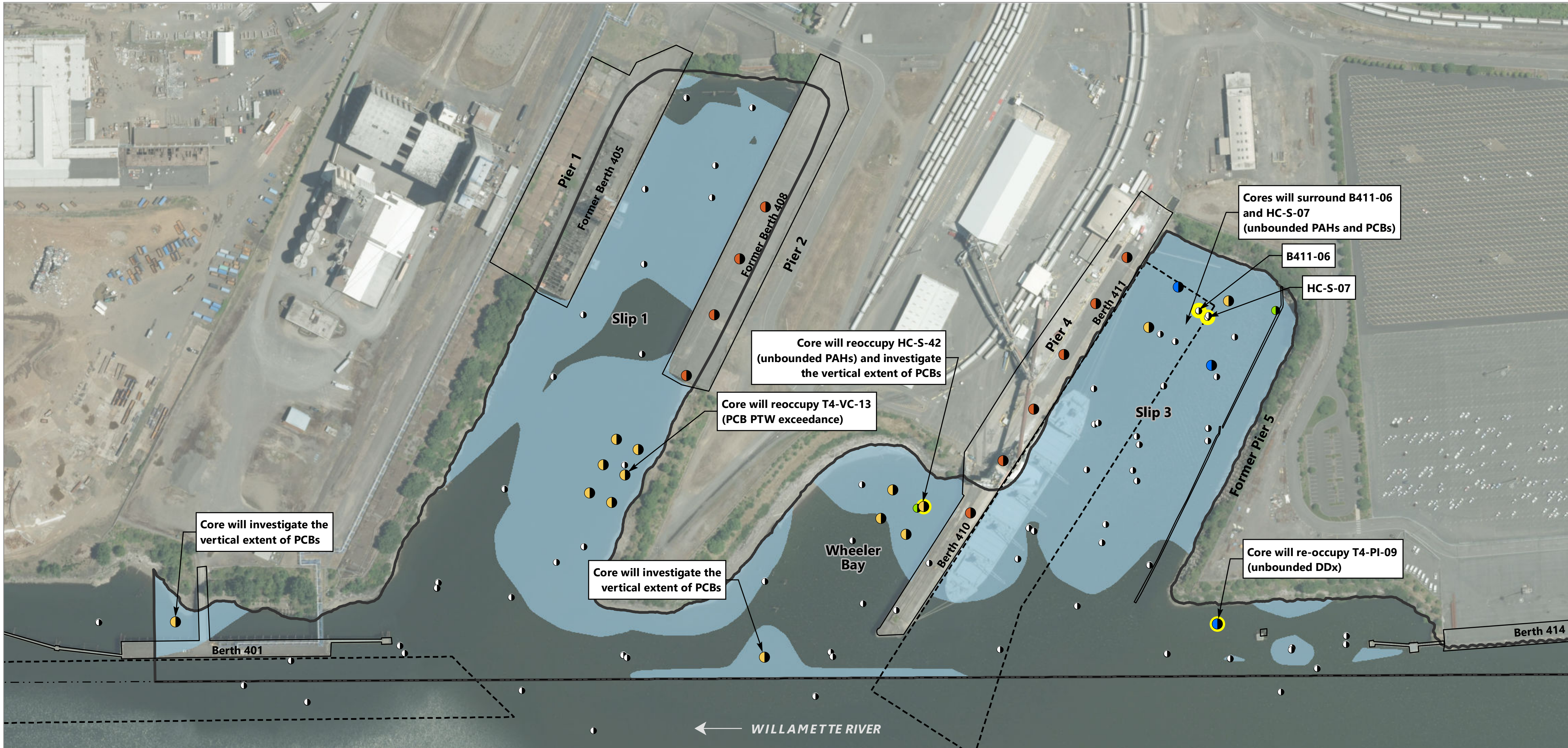
ANCHOR QEA

Figure 5-1

Proposed Surface Sediment Sampling Locations

Terminal 4 Pre-Remedial Design Investigation Work Plan

Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- Potential Maintenance Dredging
- ROD SMAs (USEPA 2017b)
- Existing Subsurface Core Locations
- Vertical Extent Not Defined
- Pre-RD Group Subsurface Core Samples

Recommended Samples

- Subsurface Core + Surface Grab
- Underpier Subsurface Core + Surface Grab
- Subsurface Core Only

NOTES:

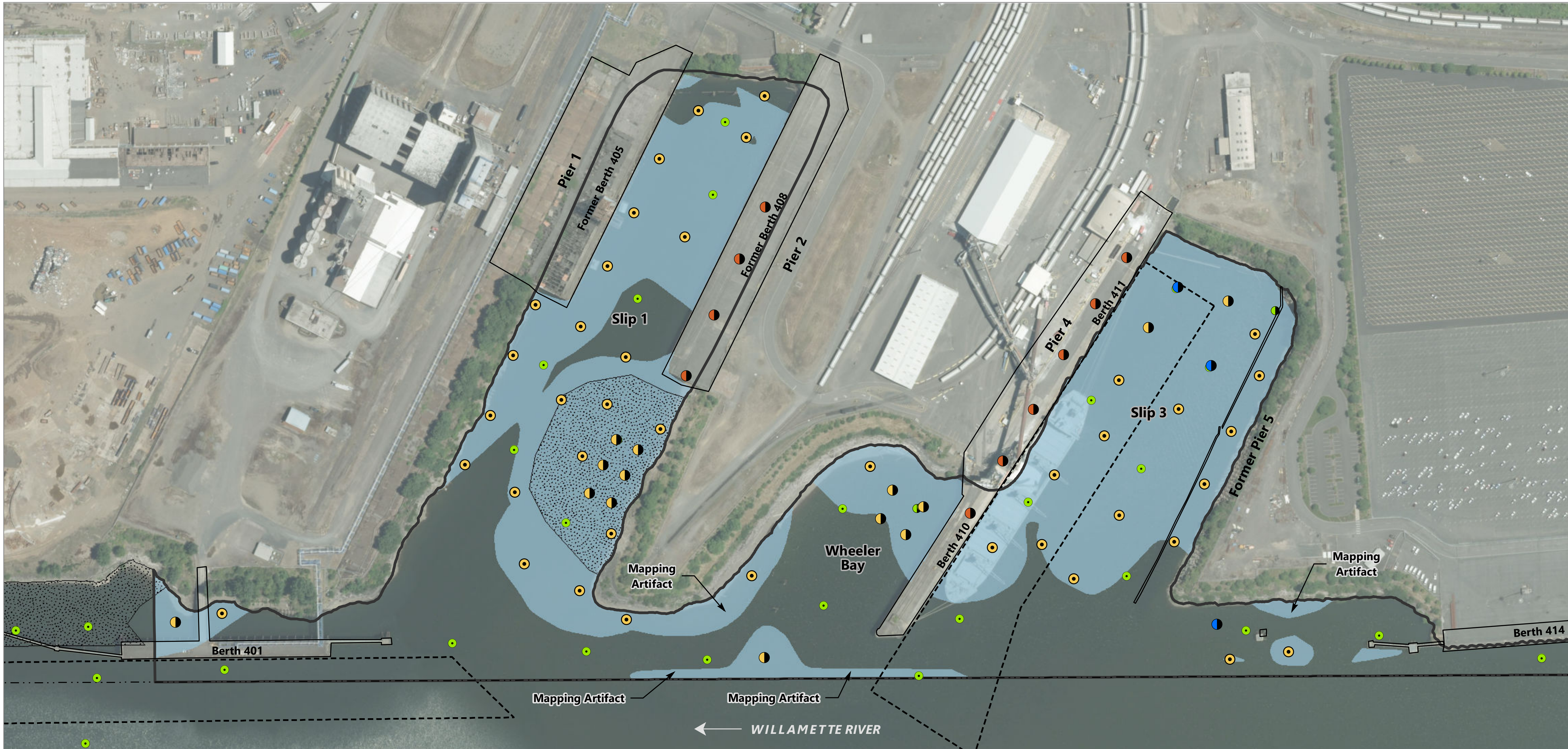
1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Unbounded cores that are adjacent to a bounded core for the same focused COC (see Figure 2-9) or outside of the SMA are not shown on this map as these locations are not considered subsurface data gaps. A discussion of these locations is provided in Section 2.3.
6. Proposed Subsurface Core Only locations are approxmately co-located with Pre-RD group surface grab sample locations (see Figure 5-3).
7. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

0 250
Feet

Publish Date: 2018/12/26, 1:15 PM | User: joliver
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig5-2_ProposedSubsurfaceSamples.mxd

ANCHOR QEA

Figure 5-2
Proposed Subsurface Sediment Sampling Locations
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy



LEGEND:

- Sediment Decision Unit RM 4.5E
- Navigation Channel
- Shoreline Structures
- Potential Maintenance Dredging
- ROD SMAs (USEPA 2017b)
- Total PCBs Surface PTW
- Pre-RD Group Surface Grab Samples
- Pre-RD Group Subsurface Core Samples

Recommended Samples

- Surface Grab Samples
- Subsurface Core + Surface Grab
- Underpier Subsurface Core + Surface Grab
- Subsurface Core Only

NOTES:

1. Arrow indicates direction of flow of river.
2. Horizontal datum is NAD83 Oregon State Plane North, International Feet.
3. Aerial imagery from City of Portland 2016.
4. SDU boundary extends approximately 1,000 feet upstream from the extent shown.
5. Proposed Subsurface Core Only locations are approxmately co-located with Pre-RD group surface grab sample locations.
6. SMAs are shown only within the Portland Harbor RI/FS Study Area Boundary (below +13 feet NAVD88).

0 250
Feet

Publish Date: 2018/12/26, 1:15 PM | User: joliver
Filepath: \\orcas\gis\Jobs\PortOfPortland_0332\PortlandHarborFS\Maps\Reports\PDIWorkPlan\AQ_PDIWP_Fig5-3_ProposedSamples.mxd

ANCHOR QEA

Figure 5-3
Proposed Sediment Sampling Locations
Terminal 4 Pre-Remedial Design Investigation Work Plan
Terminal 4 Remedy

Appendix A
Sampling Quality Assurance Project Plan

Appendix B
Health and Safety Plan

Appendix C
Supporting Upland/Source Control Documentation

Appendix C-1: Riverbank Soil Samples in Slip 1 and Wheeler Bay
(Excerpts from Ash Creek and NewFields 2007)

Appendix C-2: Riverbank Soil Samples in Slip 3
(Excerpts from Ash Creek 2009)

Appendix C-1
Riverbank Soil Samples in Slip 1 and Wheeler Bay

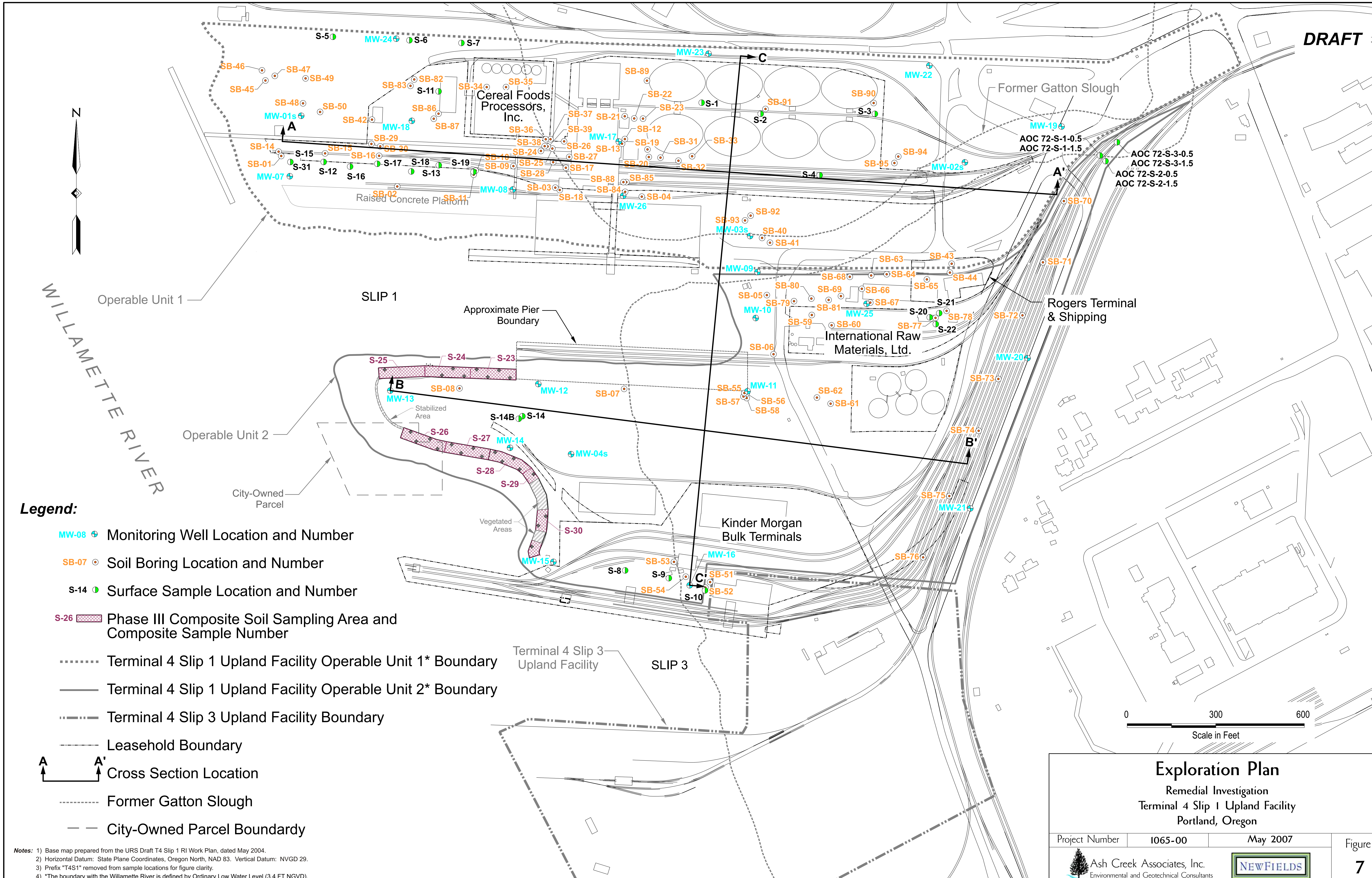
Excerpts from Ash Creek and NewFields 2007

REPORT

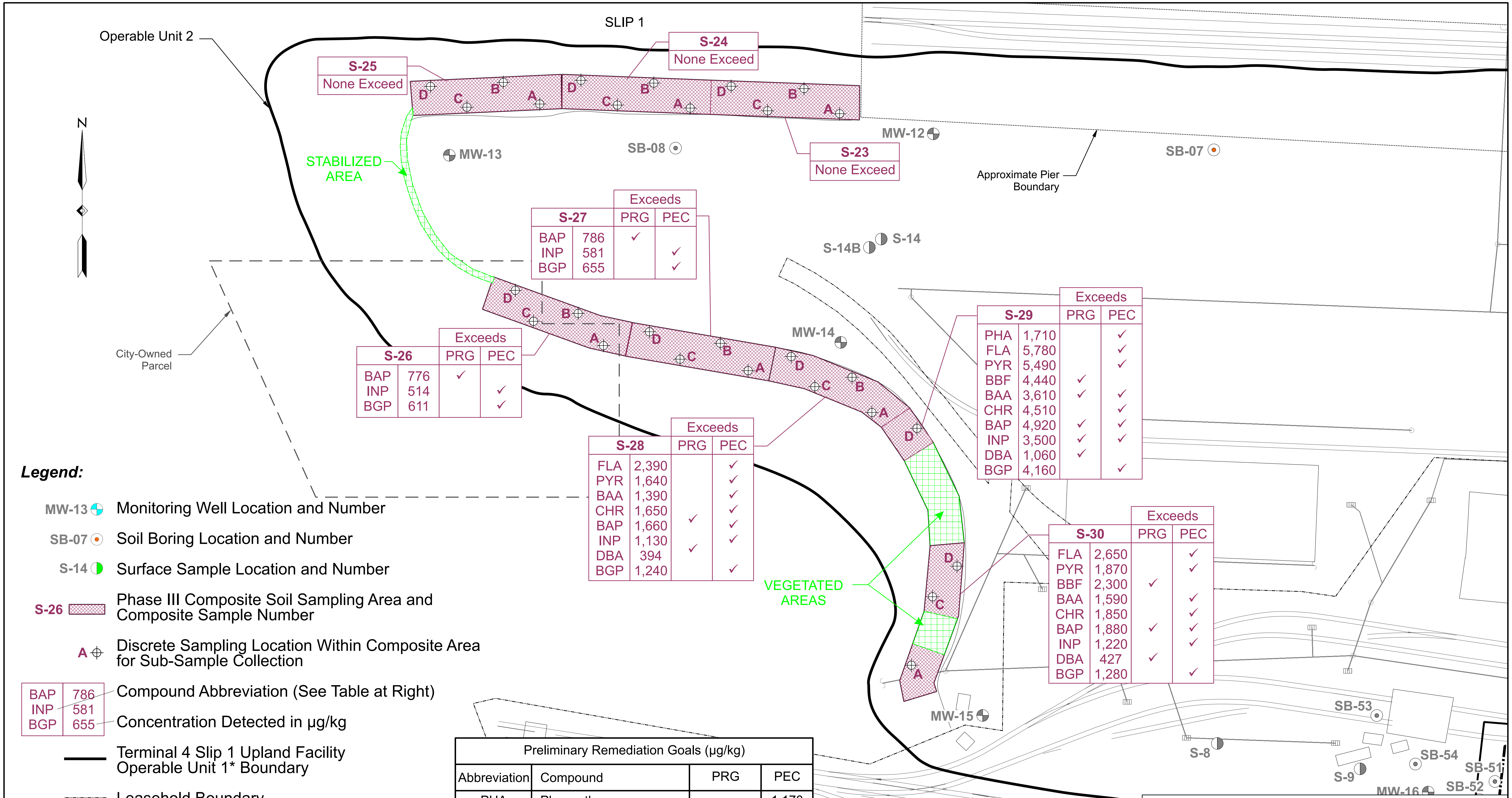
Remedial Investigation Report
Terminal 4 Slip 1 Upland Facility

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

NEWFIELDS



DRAFT
Former Gatton Slough
Cereal Foods Processors, Inc.
Raised Concrete Platform
WILLAMETTE RIVER
Operable Unit 1
SLIP 1
Approximate Pier Boundary
Rogers Terminal & Shipping
International Raw Materials, Ltd.
Operable Unit 2
Stabilized Area
City-Owned Parcel
Vegetated Areas
Kinder Morgan Bulk Terminals
Terminal 4 Slip 3 Upland Facility
SLIP 3
AOC 72-S-1-0.5
AOC 72-S-1-1.5
AOC 72-S-3-0.5
AOC 72-S-3-1.5
AOC 72-S-2-0.5
AOC 72-S-2-1.5
A
A'
B
B'
C
C'
N
0
300
600
Scale in Feet
Legend:
MW-08 Monitoring Well Location and Number
SB-07 Soil Boring Location and Number
S-14 Surface Sample Location and Number
S-26 Phase III Composite Soil Sampling Area and Composite Sample Number
Terminal 4 Slip 1 Upland Facility Operable Unit 1* Boundary
Terminal 4 Slip 1 Upland Facility Operable Unit 2* Boundary
Terminal 4 Slip 3 Upland Facility Boundary
Leasehold Boundary
A A' Cross Section Location
Former Gatton Slough
City-Owned Parcel Boundardy
Notes: 1) Base map prepared from the URS Draft T4 Slip 1 RI Work Plan, dated May 2004.
2) Horizontal Datum: State Plane Coordinates, Oregon North, NAD 83. Vertical Datum: NVGD 29.
3) Prefix "T4S1" removed from sample labels for figure clarity.
4) *The boundary with the Willamette River is defined by Ordinary Low Water Level (3.4 FT NGVD).
Exploration Plan
Remedial Investigation
Terminal 4 Slip 1 Upland Facility
Portland, Oregon
Project Number
1065-00
May 2007
Figure
7
Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants
NEWFIELDS



S-27		Exceeds PRG	Exceeds PEC
BAP	786	✓	
INP	581		✓
BGP	655		✓

S-26		Exceeds PRG	Exceeds PEC
BAP	776	✓	
INP	514		✓
BGP	611		✓

S-28		Exceeds PRG	Exceeds PEC
FLA	2,390		✓
PYR	1,640		✓
BAA	1,390		✓
CHR	1,650		✓
BAP	1,660	✓	✓
INP	1,130		✓
DBA	394	✓	
BGP	1,240		✓

S-29		Exceeds PRG	Exceeds PEC
PHA	1,710		✓
FLA	5,780		✓
PYR	5,490		✓
BBF	4,440	✓	
BAA	3,610	✓	✓
CHR	4,510		✓
BAP	4,920	✓	✓
INP	3,500	✓	✓
DBA	1,060	✓	
BGP	4,160		✓

S-30		Exceeds PRG	Exceeds PEC
FLA	2,650		✓
PYR	1,870		✓
BBF	2,300	✓	
BAA	1,590		✓
CHR	1,850		✓
BAP	1,880	✓	✓
INP	1,220		✓
DBA	427	✓	
BGP	1,280		✓

Legend:

- MW-13 Monitoring Well Location and Number
- SB-07 Soil Boring Location and Number
- S-14 Surface Sample Location and Number
- S-26 Phase III Composite Soil Sampling Area and Composite Sample Number
- A Discrete Sampling Location Within Composite Area for Sub-Sample Collection
- BAP / INP / BGP — Compound Abbreviation (See Table at Right)
- 786 / 581 / 655 — Concentration Detected in µg/kg
- Terminal 4 Slip 1 Upland Facility Operable Unit 1* Boundary
- Leasehold Boundary
- Under ground Storm Sewer Piping
- Catch Basin
- City-Owned Parcel Boundary

Preliminary Remediation Goals (µg/kg)			
Abbreviation	Compound	PRG	PEC
PHA	Phenanthrene	--	1,170
FLA	Fluoranthene	22,000,000	2,230
PYR	Pyrene	29,000,000	1,520
BBF	Benzo (b) fluoranthene	2,100	--
BAA	Benzo (a) anthracene	2,100	1,050
CHR	Chrysene	210,000	1,290
BAP	Benzo (a) pyrene	210	1,450
INP	Indeno (1,2,3-cd) pyrene	2,100	100
DBA	Dibenzo (a,h) anthracene	210	1,300
BGP	Benzo (g,h,i) perylene	--	300

Notes:
1) Base map prepared from the URS Draft T4 Slip 1 RI Work Plan, dated May 2004.
2) Horizontal Datum: State Plane Coordinates, Oregon North, NAD 83. Vertical Datum: NVGD 29.
3) *The boundary with the Willamette River is defined by Ordinary Low Water Level (3.4 FT NGVD).
4) Prefix "T4S1" removed from sample locations for figure clarity.
5) See Table 7 for Discrete Sample Results.
6) PRG = EPA Region 9 Preliminary Remediation Goal (PRG) for Industrial Soil (EPA, 2004a).
7) PEC = Probable Effect Concentration Obtained From Table 3-1 of the DEQ Joint Source Control Strategy Document.

Exceedances of Preliminary Screening Levels: Polynuclear Aromatic Hydrocarbons in Riverbank Area - OU2

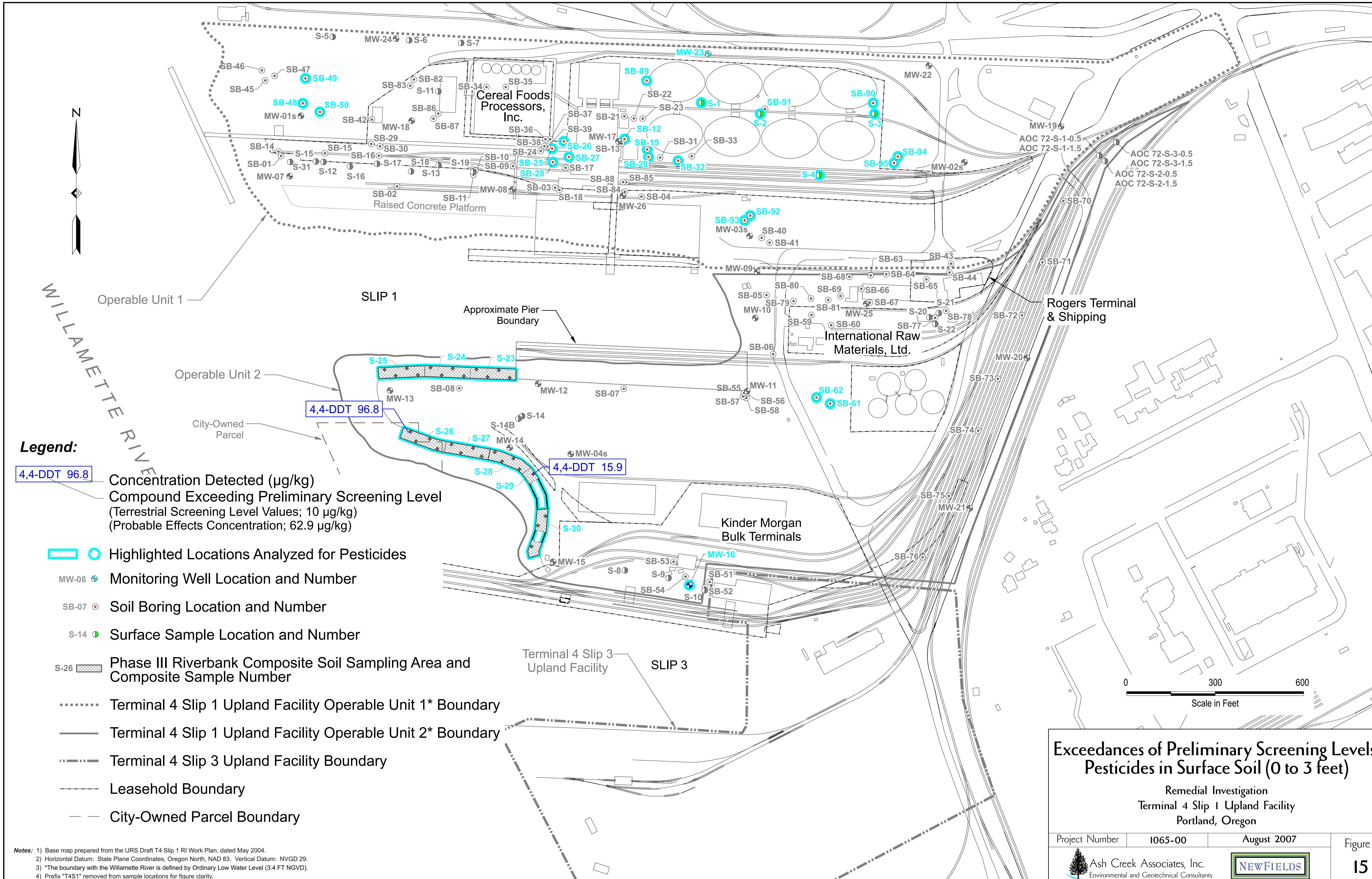
Remedial Investigation
Terminal 4 Slip 1 Upland Facility
Portland, Oregon

Project Number 1065-00 | August 2007

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

NEWFIELDS

Figure 14



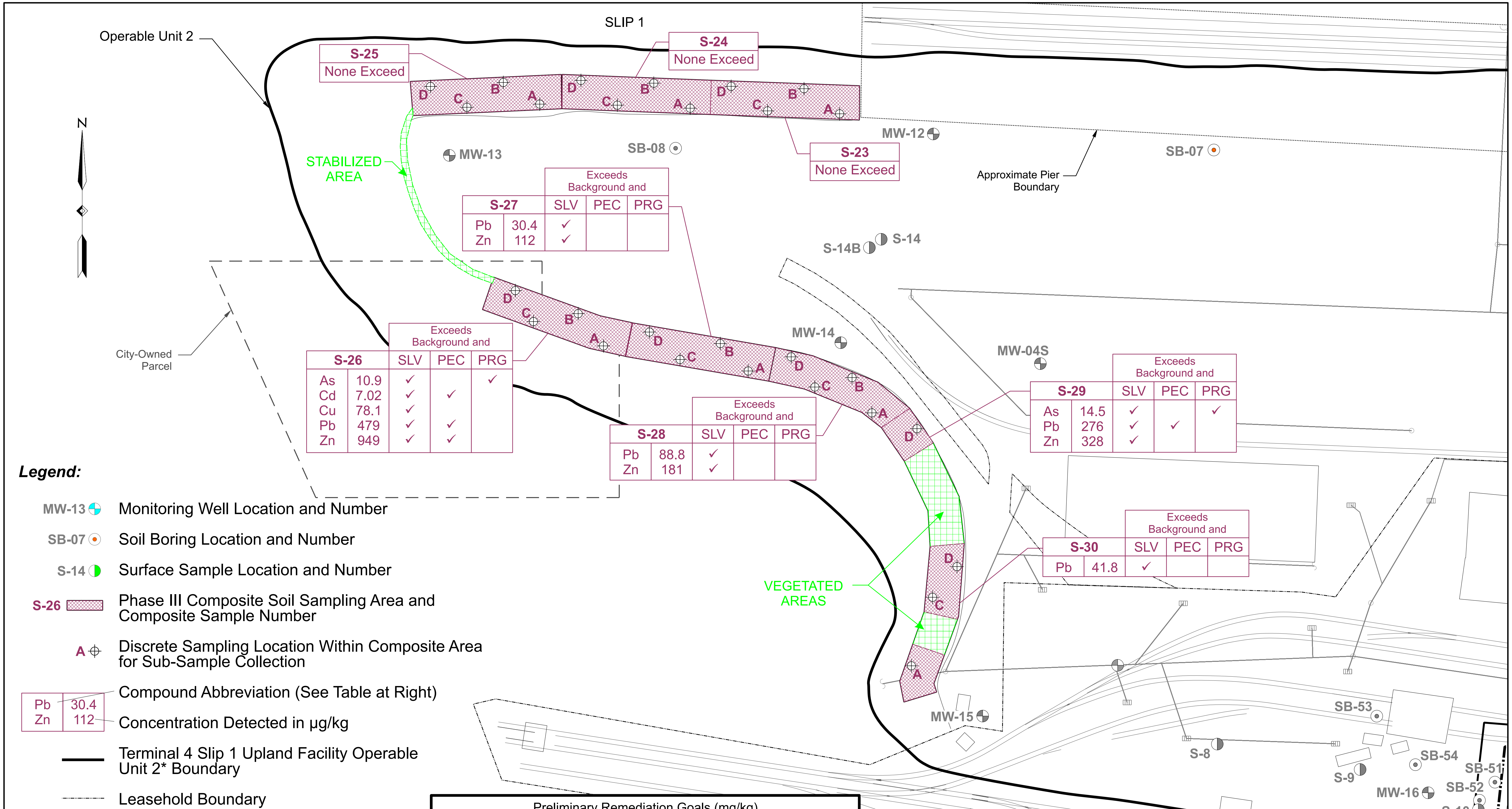
Notes:
1) Base map prepared from the URS Draft T4 Slip 1 RI Work Plan, dated May 2004.
2) Horizontal Datum: State Plane Coordinates, Oregon North, NAD 83. Vertical Datum: NVGD 29.
3) *The boundary with the Willamette River is defined by Ordinary Low Water Level (3.4 FT NGVD).
4) Prefix "T4S1" removed from sample locations for figure clarity.

Exceedances of Preliminary Screening Levels: Pesticides in Surface Soil (0 to 3 feet)

Remedial Investigation
Terminal 4 Slip 1 Upland Facility
Portland, Oregon

Project Number	1065-00	August 2007	Figure 15

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants
NEWFIELDS



Preliminary Remediation Goals (mg/kg)					
Abbreviation	Compound	Background	Terrestrial SLV	PEC	PRG
As	Arsenic	5	10	33	1.6
Cd	Cadmium	0.9	4	4.98	450
Cu	Copper	34	50	149	4,1000
Pb	Lead	17	16	128	800
Hg	Mercury	0.04	0.1	1.06	310
Zn	Zinc	95	50	459	100,000

Notes: 1) Base map prepared from the URS Draft T4 Slip 1 RI Work Plan, dated May 2004.
2) Horizontal Datum: State Plane Coordinates, Oregon North, NAD 83. Vertical Datum: NVGD 29.
3) *The boundary with the Willamette River is defined by Ordinary Low Water Level (3.4 FT NGVD).
4) Prefix "T4S1" removed from sample locations for figure clarity.
5) See Table 12 for Discrete Sample Results.
6) SLV = Oregon DEQ Level II Screening Level Values (SLVs) for Terrestrial Receptors (DEQ, 2001).
7) Background levels are from the Washington Department of Ecology's Publication 94-115 (Ecology, 1994).
8) PEC = Probable Effect Concentration Obtained From Table 3-1 of the DEQ Joint Source Control Strategy Document.

0 100 200
Scale in Feet

Exceedances of Preliminary Screening Levels: Metals in Riverbank Area - OU2

Remedial Investigation
Terminal 4 Slip 1 Upland Facility
Portland, Oregon

Project Number 1065-00 | August 2007 | Figure 18

Ash Creek Associates, Inc. Environmental and Geotechnical Consultants
NEWFIELDS

Terminal 4 Slip 1 Operable Unit 2
Riverbank Surface Soil Sampling Results
Port of Portland
Portland, Oregon

Sample ID	River Bank/ Sediment CLs	JSCS SLVs	S-23	S-23A	S-23B	S-23C	S-23D	S-24	S-24A	S-24B	S-24C	S-24D	S-25	S-25A	S-25B	S-25C
Sample Location			T4S1S-23	T4S1S-23A	T4S1S-23B	T4S1S-23C	T4S1S-23D	T4S1S-24	T4S1S-24A	T4S1S-24B	T4S1S-24C	T4S1S-24D	T4S1S-25	T4S1S-25A	T4S1S-25B	T4S1S-25C
Sample Type			Composite	Discrete	Discrete	Discrete	Discrete	Composite	Discrete	Discrete	Discrete	Discrete	Composite	Discrete	Discrete	Discrete
Sample Interval (feet)			0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
Date Sampled			9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005
Operable Unit			OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2
Metals by EPA 6000/7000 Series (mg/kg)																
Antimony		64	1.48 U, D	--	--	--	--	1.58 U, D	--	--	--	--	1.59 U	--	--	--
Arsenic	3		2.81 D	--	--	--	--	3.08 D	--	--	--	--	2.69	--	--	--
Beryllium			0.326 J, D	--	--	--	--	0.321 J, D	--	--	--	--	0.296 J	--	--	--
Cadmium	0.51		0.158 J, D	--	--	--	--	0.11 J, D	--	--	--	--	0.122 J	--	--	--
Chromium		111	13.4 D	--	--	--	--	14.8 D	--	--	--	--	13.9	--	--	--
Copper	359		13.5 D	--	--	--	--	13.7 D	--	--	--	--	14.1	--	--	--
Lead	196		6.24 D	--	--	--	--	4.59 D	--	--	--	--	5.07	--	--	--
Mercury	0.085		*0.0954 U, D*	--	--	--	--	0.0092 J, D	--	--	--	--	0.0108 J, D	--	--	--
Nickel		48.6	16.7 D	--	--	--	--	18 D	--	--	--	--	19.2	--	--	--
Selenium		5	0.252 J, D	--	--	--	--	0.479 J, D	--	--	--	--	0.338 J	--	--	--
Silver		5	0.495 U, D	--	--	--	--	0.526 U, D	--	--	--	--	0.529 U	--	--	--
Thallium			0.495 U, D	--	--	--	--	0.526 U, D	--	--	--	--	0.529 U	--	--	--
Zinc	459		52.6 D	--	--	--	--	52.9 D	--	--	--	--	55.9	--	--	--
Pesticides by EPA 8081/8141 (µg/kg)																
delta-BHC			1.06 U, D	7.22 U	1.44 U	1.43 U	1.44 U	1.09 U, D	1.45 U	1.48 U	1.46 U	1.4 U	1.07 U, D	1.49 U	1.39 U	1.42 U
Heptachlor		10	1.06 U, D	7.22 U	1.44 U	1.43 U	1.44 U	1.09 U, D	1.45 U	1.48 U	1.46 U	1.4 U	1.07 U, D	1.49 U	1.39 U	1.42 U
Heptachlor Epoxide		16	1.06 U, D	7.22 U	1.44 U	1.43 U	1.44 U	1.09 U, D	1.45 U	1.48 U	1.46 U	1.4 U	1.07 U, D	1.49 U	1.39 U	1.42 U
Aldrin	2		1.06 U, D	7.22 U	1.44 U	1.43 U	1.44 U	1.09 U, D	1.45 U	1.48 U	1.46 U	1.4 U	1.07 U, D	1.49 U	1.39 U	1.42 U
gamma-Chlordane	1.4		1.06 U, D	*7.22 U*	*1.44 U*	*1.43 U*	*1.44 U*	1.09 U, D	*1.45 U*	*1.48 U*	*1.46 U*	*1.4 U*	1.07 U, D	*1.49 U*	1.39 U	*1.42 U*
Endosulfan I			0.329 J, D	7.22 U	1.44 U	1.43 U	1.44 U	1.09 U, D	1.45 U	1.48 U	1.46 U	1.4 U	1.07 U, D	1.49 U	1.39 U	1.42 U
alpha-Chlordane	1.4		1.06 U, D	*7.22 U*	*1.44 U*	*1.43 U*	*1.44 U*	1.09 U, D	*1.45 U*	*1.48 U*	*1.46 U*	*1.4 U*	1.07 U, D	*1.49 U*	1.39 U	*1.42 U*
Dieldrin	0.07		*2.13 U, D*	*7.22 U*	*1.44 U*	*1.43 U*	*1.44 U*	*2.17 U, D*	*1.45 U*	*1.48 U*	*1.46 U*	*1.4 U*	*2.14 U, D*	*1.49 U*	*1.39 U*	*1.42 U*
4,4'-DDE	226		2.13 U, D	7.22 U	1.44 U	1.43 U	1.44 U	2.17 U, D	1.45 U	1.48 U	1.46 U	1.4 U	2.14 U, D	1.49 U	1.39 U	1.42 U
Endrin		207	2.13 U, D	7.22 U	1.44 U	1.43 U	1.44 U	2.17 U, D	1.45 U	1.48 U	1.46 U	1.4 U	2.14 U, D	1.49 U	1.39 U	1.42 U
4,4'-DDD	114		2.13 U, D	7.22 U	1.44 U	1.43 U	1.44 U	2.17 U, D	1.45 U	1.48 U	1.46 U	1.4 U	2.14 U, D	1.49 U	1.39 U	1.42 U
Endrin Aldehyde			2.13 U, D	7.22 U	1.44 U	1.43 U	1.44 U	2.17 U, D	1.45 U	1.48 U	1.46 U	1.4 U	2.14 U, D	1.49 U	1.39 U	1.42 U
4,4'-DDT	246		0.7 J, D	7.22 U	1.44 U, D	1.43 U, D	1.44 U	0.434 J, D	1.45 U	1.48 U, D	1.46 U, D	1.4 U	0.511 J, D	1.49 U, D	1.39 U, D	1.42 U, D
Endrin Ketone			2.13 U, D	7.22 U	1.44 U	1.43 U	1.44 U	2.17 U, D	1.45 U	1.48 U	1.46 U	1.4 U	2.14 U, D	1.49 U	1.39 U	1.42 U
Methoxychlor			2.13 U, D	7.22 U	1.44 U, D	1.43 U	1.44 U	2.17 U, D	1.45 U	1.48 U	1.46 U	1.4 U	2.14 U, D	1.49 U	1.39 U	1.42 U
NWTPH-Dx (mg/kg)																
Diesel Range	91		26.6 U	--	--	--	--	27.1 U	--	--	--	--	29.5 U	--	--	--
Residual Range			53.1 U, D	--	--	--	--	54.2 U	--	--	--	--	59 U	--	--	--
PAHs by EPA 8270-SIM (µg/kg)																
Naphthalene		561	14.2 U	--	--	--	--	14.3 U	--	--	--	--	15.8 U	--	--	--
2-Methylnaphthalene		200	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene		200	4.74 J, D	--	--	--	--	14.3 U	--	--	--	--	15.8 U	--	--	--
Acenaphthene		300	14.2 U	--	--	--	--	14.3 U	--	--	--	--	15.8 U	--	--	--
Fluorene		536	14.2 U	--	--	--	--	14.3 U	--	--	--	--	15.8 U	--	--	--
Dibenzofuran			--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene		1,170	10.9 J, D	--	--	--	--	9.65 J, D	--	--	--	--	37.7 D	--	--	--
Anthracene		845	17.6 D	--	--	--	--	14.3 U	--	--	--	--	6.51 J, D	--	--	--
Fluoranthene		2,230	28.9 D	--	--	--	--	26.5 D	--	--	--	--	104 D	--	--	--
Pyrene		1520	22.3 D	--	--	--	--	19.5 D	--	--	--	--	75.1 D	--	--	--
Benzo(b)fluoranthene			59.6 D	--	--	--	--	21.3 D	--	--	--	--	102 D	--	--	--
Benzo(k)fluoranthene		13,000	37.9 D	--	--	--	--	17.2 D	--	--	--	--	58.8 D	--	--	--
Benzo(a)anthracene		1,050	30.8 D	--	--	--	--	15.1 D	--	--	--	--	62.3 D	--	--	--
Chrysene		1,290	77.4 D	--	--	--	--	17.9 D	--	--	--	--	70.7 D	--	--	--
Benzo(a)pyrene		1,450	48.1 D	--	--	--	--	20.9 D	--	--	--	--	89.1 D	--	--	--
Indeno(1,2,3-cd)pyrene		100	46.4 D	--	--	--	--	15.4 D	--	--	--	--	62.8 D	--	--	--
Dibenz(a,h)anthracene		1,300	14.9 D	--	--	--	--	4.79 J, D	--	--	--	--	20.5 D	--	--	--
Benzo(g,h,i)perylene		300	50.9 D	--	--	--	--	17.5 D	--	--	--	--	70.2 D	--	--	--
BaP Eq (cPAHs)	12		77.6	--	--	--	--	31.2	--	--	--	--	133.7	--	--	--
PAHs (total)	23,000		--	--	--	--	--	--	--	--	--	--	--	--	--	--

Please refer to notes at end of table.

Terminal 4 Slip 1 Operable Unit 2
Riverbank Surface Soil Sampling Results
Port of Portland
Portland, Oregon

Sample ID	River Bank/ Sediment CLs	JSCS SLVs	S-23	S-23A	S-23B	S-23C	S-23D	S-24	S-24A	S-24B	S-24C	S-24D	S-25	S-25A	S-25B	S-25C
Sample Location			T4S1S-23	T4S1S-23A	T4S1S-23B	T4S1S-23C	T4S1S-23D	T4S1S-24	T4S1S-24A	T4S1S-24B	T4S1S-24C	T4S1S-24D	T4S1S-25	T4S1S-25A	T4S1S-25B	T4S1S-25C
Sample Type			Composite	Discrete	Discrete	Discrete	Discrete	Composite	Discrete	Discrete	Discrete	Discrete	Composite	Discrete	Discrete	Discrete
Sample Interval (feet)			0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
Date Sampled			9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005	9/12/2005
Operable Unit			OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2
SVOCs by EPA 8270C (µg/kg)																
Phenol		50	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl Phthalate		60	14.2 U	--	--	--	--	14.4 U	--	--	--	--	15.9 U	--	--	--
Bis(2-ethylhexyl) Phthalate	135		14.2 U	--	--	--	--	14.4 U	--	--	--	--	17.6 D	--	--	--
VOCs by EPA 8260B (µg/kg)																
Acetone			--	--	--	--	2650 U	--	--	--	--	--	--	--	--	--
Carbon Disulfide			--	--	--	--	1060 U	--	--	--	--	--	--	--	--	--
Dichloromethane (Methylene Chloride)			--	--	--	--	529 U, D	--	--	--	--	--	--	--	--	--
2-Butanone (MEK)			--	--	--	--	1060 U	--	--	--	--	--	--	--	--	--
Chloroform			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
Benzene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
Trichloroethene (TCE)		2100	--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
Toluene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
Tetrachloroethene (PCE)		500	--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
Chlorobenzene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
Ethylbenzene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
m,p-Xylenes			--	--	--	--	212 U, D	--	--	--	--	--	--	--	--	--
o-Xylene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
Isopropylbenzene			--	--	--	--	212 U	--	--	--	--	--	--	--	--	--
n-Propylbenzene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene			--	--	--	--	83.6 J, D	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
sec-Butylbenzene			--	--	--	--	22.2 J, D	--	--	--	--	--	--	--	--	--
4-Isopropyltoluene			--	--	--	--	21.2 J, D	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene			--	--	--	--	106 U	--	--	--	--	--	--	--	--	--
n-Butylbenzene			--	--	--	--	43.4 J, D	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene			--	--	--	--	226 J, D	--	--	--	--	--	--	--	--	--
Naphthalene			--	--	--	--	212 U	--	--	--	--	--	--	--	--	--
PCBs by EPA 8082 (mg/kg)																
Aroclor 1254		300	0.0355 U	--	--	--	--	0.0359 U	--	--	--	--	0.0394 U	--	--	--
Aroclor 1260		200	0.0355 U	--	--	--	--	0.0359 U	--	--	--	--	0.0394 U	--	--	--
Aroclor 1262			--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1268			--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	9		--	--	--	--	--	--	--	--	--	--	--	--	--	--

Please refer to notes at end of table.

Terminal 4 Slip 1 Operable Unit 2
Riverbank Surface Soil Sampling Results
Port of Portland
Portland, Oregon

Sample ID	River Bank/ Sediment CLs	JSCS SLVs	S-25D	S-26	S-26A	S-26B	S-26C	S-26D	S-27	S-27A	S-27B	S-27C	S-27D	S-28	S-28A	S-28B	S-28C
Sample Location			T4S1S-25D	T4S1S-26	T4S1S-26A	T4S1S-26B	T4S1S-26C	T4S1S-26D	T4S1S-27	T4S1S-27A	T4S1S-27B	T4S1S-27C	T4S1S-27D	T4S1S-28	T4S1S-28A	T4S1S-28B	T4S1S-28C
Sample Type			Discrete	Composite	Discrete	Discrete	Discrete	Discrete	Composite	Discrete	Discrete	Discrete	Discrete	Composite	Discrete	Discrete	Discrete
Sample Interval (feet)			0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
Date Sampled			9/12/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005
Operable Unit			OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2
Metals by EPA 6000/7000 Series (mg/kg)																	
Antimony		64	--	0.0728 J	1.53 U	1.53 U	1.54 U	1.74 U	1.53 U	--	--	--	--	1.53 U	--	--	--
Arsenic	3		--	10.9	2.49	2.23	2.97	15.7	2.59	--	--	--	--	3.72	--	--	--
Beryllium			--	0.26 J	0.209 J	0.285 J	0.277 J	0.186 J	0.295 J	--	--	--	--	0.316 J	--	--	--
Cadmium	0.51		--	7.02	0.22 J	0.27 J	0.646	25.3	0.402 J	--	--	--	--	0.815	--	--	--
Chromium		111	--	16.4	12.3	14.5	15.2	23.6	16	--	--	--	--	16.6	--	--	--
Copper	359		--	78.1	12	14	16.9	219 D	16.7	--	--	--	--	19.5	--	--	--
Lead	196		--	479 D	7.78	12.6	43.6	868 D	30.4	--	--	--	--	88.8	--	--	--
Mercury	0.085		--	0.0947 J	*0.126 U, D*	*0.131 U, D*	*0.13 U, D*	0.325 D	*0.102 U*	--	--	--	--	0.0261 J, D	--	--	--
Nickel		48.6	--	18.4	16.2	16.6	17.5	19.3	19.5	--	--	--	--	19	--	--	--
Selenium		5	--	0.286 J	0.184 J	0.163 J	0.159 J	0.407 J	0.229 J	--	--	--	--	0.295 J	--	--	--
Silver		5	--	1.16	0.511 U	0.509 U	0.123 J	2.1	0.509 U	--	--	--	--	0.0967 J	--	--	--
Zinc	459		--	0.0624 J	0.511 U	0.509 U	0.513 U	0.122 J	0.509 U	--	--	--	--	0.509 U	--	--	--
			--	949 D	55.7	64	127	3320 D	112	--	--	--	--	181	--	--	--
Pesticides by EPA 8081/8141 (µg/kg)																	
delta-BHC			1.39 U	1.04 U, D	1.37 U	6.87 U	1.39 U	7.7 U	1.02 U, D	6.78 U	1.35 U	1.37 U	1.37 U	1.01 U, D	1.03 U	1.02 U	1.02 U
Heptachlor		10	1.39 U	1.04 U, D	1.37 U	6.87 U	1.39 U	7.7 U	1.02 U, D	6.78 U	1.35 U	1.37 U	1.37 U	1.01 U, D	1.03 U	1.02 U	1.02 U
Heptachlor Epoxide		16	1.39 U	1.04 U, D	1.37 U	6.87 U	1.39 U	7.7 U	1.02 U, D	6.78 U	1.35 U	1.37 U	1.37 U	1.01 U, D	1.03 U	1.02 U	1.02 U
Aldrin	2		1.39 U	1.04 U, D	1.37 U	6.87 U	1.39 U	7.7 U	1.02 U, D	6.78 U	1.35 U	1.37 U	1.37 U	1.01 U, D	1.03 U	1.02 U	1.02 U
gamma-Chlordane	1.4		1.39 U	1.04 U, D	1.37 U	*6.87 U*	1.39 U	*7.7 U*	1.02 U, D	*6.78 U*	1.35 U	1.37 U	1.37 U	1.01 U, D	1.03 U	1.02 U	1.02 U
Endosulfan I			1.39 U	1.04 U, D	1.37 U	6.87 U	1.39 U	7.7 U	1.02 U, D	6.78 U	1.35 U	1.37 U	1.37 U	1.01 U, D	1.03 U	1.02 U	1.02 U
alpha-Chlordane	1.4		1.39 U	1.04 U, D	1.37 U	*6.87 U*	1.39 U	*77 U*	1.02 U, D	*67.8 U*	1.35 U	1.37 U	1.37 U	1.01 U, D	1.03 U	1.02 U	1.02 U
Dieldrin	0.07		*1.39 U*	0.761 J, D	*1.37 U*	*68.7 U*	*1.39 U*	*77 U*	*2.04 U, D*	*67.8 U*	*1.35 U*	*1.37 U*	*1.37 U*	*2.03 U, D*	*2.06 U*	0.274 J	*2.05 U*
4,4'-DDE	226		1.39 U	5.22 D	1.37 U	68.7 U	1.39 U	77 U	1.83 J, D	6.78 U	1.35 U	1.37 U	1.37 U	1.72 J, D	2.06 U	2.04 U	2.05 U
Endrin		207	1.39 U	2.09 U, D	1.37 U	6.87 U	1.39 U	7.7 U	2.04 U, D	67.8 U	1.35 U	1.37 U	1.37 U	2.03 U, D	2.06 U	2.04 U	2.05 U
4,4'-DDD	114		1.39 U	2.37 D	1.37 U	6.87 U	1.39 U	7.7 U	2.04 U, D	6.78 U	1.35 U	0.873 J, D	1.37 U	2.03 U, D	2.06 U	2.04 U	2.05 U
Endrin Aldehyde			1.39 U	2.09 U, D	1.37 U	6.87 U	1.39 U	77 U	2.04 U, D	67.8 U	1.35 U	1.37 U	1.37 U	2.03 U, D	2.06 U	2.04 U	2.05 U
4,4'-DDT	246		1.39 U	17.2 D	1.37 U, D	6.87 U	1.11 J, D	96.8 D	3.66 D	67.8 U	1.35 U, D	1.37 U, D	1.37 U, D	3.43 D	3.72	0.648 J	0.925 J
Endrin Ketone			1.39 U	2.09 U, D	1.37 U	6.87 U	1.39 U	77 U	2.04 U, D	67.8 U	1.35 U	1.37 U	1.37 U	2.03 U, D	2.06 U	2.04 U	2.05 U
Methoxychlor			1.39 U	2.09 U, D	1.37 U	68.7 U	1.39 U	77 U	2.04 U, D	67.8 U	1.35 U	1.37 U	1.37 U	2.03 U, D	2.06 U	2.04 U	2.05 U
NWTPH-Dx (mg/kg)																	
Diesel Range	91		--	26.4 U	--	--	--	--	18.7 J, D	--	--	--	--	25.4 U	--	--	--
Residual Range			--	42.2 J, D	--	--	--	--	68.2 D	--	--	--	--	34 J, D	--	--	--
PAHs by EPA 8270-SIM (µg/kg)																	
Naphthalene		561	--	30.3 J, D	13.6 U	5.55 J, D	13.9 U	83.2 D	69.2 D	269 D	13.6 U	54.7 U	54.5 U	28.3 J, D	107 D	55.2 U	13.8 U
2-Methylnaphthalene		200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Acenaphthylene		200	--	35.7 J, D	13.6 U	48.8 D	13.9 U	108 D	18.7 J, D	114 D	13.6 U	54.7 U	54.5 U	67.6 U	18.2 J, D	55.2 U	13.8 U
Acenaphthene		300	--	70.1 U	13.6 U	27.1 D	13.9 U	77.3 U	97.4 D	375 D	9.59 J, D	54.7 U	54.5 U	151 D	843 D	55.2 U	13.8 U
Fluorene		536	--	70.1 U	13.6 U	28.7 D	13.9 U	77.3 U	48 J, D	207 D	7.51 J, D	54.7 U	54.5 U	114 D	825 D	55.2 U	13.8 U
Dibenzofuran			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene		1170	--	234 D	23.2 D	361 D	25.4 D	443 D	376 D	1680 D	141 D	28.5 J, D	35 J, D	1040 D	6300 D	29.8 J, D	22.4 D
Anthracene		845	--	57 J, D	3.4 J, D	206 D	3.63 J, D	99.6 D	93.5 D	471 D	19.7 D	54.7 U	54.5 U	166 D	717 D	55.2 U	13.8 U
Fluoranthene		2230	--	962 D	87.5 D	7990 D	95.4 D	1640 D	986 D	4650 D	511 D	88.1 D	113 D	2390 D	11300 D	93.5 D	80.1 D
Pyrene		1520	--	883 D	83.6 D	7220 D	86.7 D	1750 D	722 D	3440 D	402 D	94.2 D	105 D	1640 D	8280 D	85.7 D	63.1 D
Benzo(b)fluoranthene			--	874 D	89.4 D	2270 D	94 D	1500 D	916 D	3690 D	485 D	91 D	107 D	2020 D	8010 D	87.7 D	85.4 D
Benzo(k)fluoranthene		13000	--	597 D	84.8 D	2070 D	90.2 D	1300 D	583 D	3240 D	409 D	88.6 D	101 D	1230 D	7260 D	80.7 D	64 D
Benzo(a)anthracene		1050	--	581 D	62.5 D	2380 D	68 D	1110 D	597 D	2700 D	320 D	62.9 D	74.4 D	1390 D	6580 D	61.6 D	48.4 D
Chrysene		1290	--	898 D	79.2 D	4170 D	87.3 D	1590 D	705 D	3590 D	393 D	83.2 D	98.7 D	1650 D	8190 D	83.4 D	64 D
Benzo(a)pyrene		1450	--	776 D	92.4 D	1460 D	97.4 D	1830 D	786 D	3560 D	445 D	104 D	110 D	1660 D	7790 D	85.1 D	74.5 D
Indeno(1,2,3-cd)pyrene		100	--	514 D	55.4 D	433 D	54.8 D	790 D	581 D	2280 D	181 D	60.6 D	61.4 D	1130 D	4460 D	49.1 J, D	30.5 D
Dibenz(a,h)anthracene		1300	--	151 D	17.9 D	160 D	17.7 D	183 D	194 D	795 D	64.2 D	18.2 J, D	20.4 J, D	394 D	1530 D	16.7 J, D	10.9 J, D
Benzo(g,h,i)perylene		300	--	611 D	61.4 D	358 D	60.1 D	926 D	655 D	2560 D	181 D	74.4 D	68.3 D	1240 D	4770 D	56.3 D	30.5 D
BaP Eq (cPAHs)	12		--	1136.9	132.6	2156.8	138.4	2376.9	1202.5	5283.6	614.1	145.4	156.5	2534.4	11353.5	123.1	102.8
PAHs (total)	23,000		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Please refer to notes at end of table.

Terminal 4 Slip 1 Operable Unit 2
Riverbank Surface Soil Sampling Results
Port of Portland
Portland, Oregon

Sample ID	River Bank/ Sediment CLs	JSCS SLVs	S-25D	S-26	S-26A	S-26B	S-26C	S-26D	S-27	S-27A	S-27B	S-27C	S-27D	S-28	S-28A	S-28B	S-28C
Sample Location			T4S1S-25D	T4S1S-26	T4S1S-26A	T4S1S-26B	T4S1S-26C	T4S1S-26D	T4S1S-27	T4S1S-27A	T4S1S-27B	T4S1S-27C	T4S1S-27D	T4S1S-28	T4S1S-28A	T4S1S-28B	T4S1S-28C
Sample Type			Discrete	Composite	Discrete	Discrete	Discrete	Discrete	Composite	Discrete	Discrete	Discrete	Discrete	Composite	Discrete	Discrete	Discrete
Sample Interval (feet)			0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
Date Sampled			9/12/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005
Operable Unit			OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2	OU2
SVOCs by EPA 8270C (µg/kg)																	
Phenol		50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl Phthalate		60	--	27.9 U	--	--	--	--	27 U	--	--	--	--	27.2 U	--	--	--
Bis(2-ethylhexyl) Phthalate	135		--	27.9 U	--	--	--	--	27 U	--	--	--	--	27.2 U	--	--	--
VOCs by EPA 8260B (µg/kg)																	
Acetone			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Disulfide			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dichloromethane (Methylene Chloride)			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2-Butanone (MEK)			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chloroform			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Tetrachloride			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Benzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Trichloroethene (TCE)		2100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Toluene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene (PCE)		500	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorobenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
m,p-Xylenes			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Isopropylbenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Propylbenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
sec-Butylbenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4-Isopropyltoluene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1,4-Dichlorobenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
n-Butylbenzene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hexachlorobutadiene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Naphthalene			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCBs by EPA 8082 (mg/kg)																	
Aroclor 1254		300	--	0.0516 U	--	--	--	--	0.0335 U	--	--	--	--	0.0335 U	--	--	--
Aroclor 1260		200	--	0.0344 U	--	--	--	--	0.0335 U	--	--	--	--	0.0335 U	--	--	--
Aroclor 1262			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1268			--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total PCBs	9		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Please refer to notes at end of table.

Terminal 4 Slip 1 Operable Unit 2
Riverbank Surface Soil Sampling Results
Port of Portland
Portland, Oregon

Sample ID	River Bank/ Sediment CLs	JSCS SLVs	S-28D	S-29	S-30	S-30A	S-30C	S-30D
Sample Location			T4S1S-28D	T4S1S-29	T4S1S-30	T4S1S-30A	T4S1S-30C	T4S1S-30D
Sample Type			Discrete	Discrete	Composite	Discrete	Discrete	Discrete
Sample Interval (feet)			0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
Date Sampled			9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	38608
Operable Unit			OU2	OU2	OU2	OU2	OU2	OU2
Metals by EPA 6000/7000 Series (mg/kg)								
Antimony		64	--	1.51 U, D	1.53 U	--	--	--
Arsenic	3		--	14.5 D	2.47 D	--	--	--
Beryllium			--	0.292 J, D	0.352 J, D	--	--	--
Cadmium	0.51		--	2.12 D	0.352 J, D	--	--	--
Chromium		111	--	23.8 D	16.8 D	--	--	--
Copper	359		--	38.5 D	17 D	--	--	--
Lead	196		--	276 D	41.8 D	--	--	--
Mercury	0.085		--	0.0799 J, D	0.034 J, D	--	--	--
Nickel		48.6	--	17.7 D	20.5 D	--	--	--
Selenium		5	--	0.347 J, D	0.25 J, D	--	--	--
Silver		5	--	0.66 D	0.51 U, D	--	--	--
Zinc	459		--	0.504 U, D	0.51 U, D	--	--	--
			--	328 D	91.4 D	--	--	--
Pesticides by EPA 8081/8141 (µg/kg)								
delta-BHC			1.01 U	1.03 U, D	1.03 U, D	1.03 U	1.01 U	1.04 U
Heptachlor		10	1.01 U	1.03 U, D	1.03 U, D	1.03 U	1.01 U	1.04 U
Heptachlor Epoxide		16	1.01 U	1.03 U, D	0.19 J, D	1.03 U	1.01 U	1.04 U
Aldrin	2		1.01 U	1.03 U, D	1.03 U, D	1.03 U	1.01 U	1.04 U
gamma-Chlordane	1.4		1.01 U	1.03 U, D	1.03 U, D	1.03 U	1.01 U	1.04 U
Endosulfan I			1.01 U	1.03 U, D	1.03 U, D	1.03 U	1.01 U	1.04 U
alpha-Chlordane	1.4		1.01 U	1.03 U, D	1.03 U, D	1.03 U	1.01 U	1.04 U
Dieldrin	0.07		0.808 J	*2.06 U, D*	0.397 J, D	0.896 J	*2.02 U*	0.381 J
4,4'-DDE	226		1.61 J	7.84 D	2.05 U, D	2.06 U	2.02 U	2.07 U
Endrin		207	2.01 U	2.06 U, D	2.05 U, D	2.06 U	2.02 U	2.07 U
4,4'-DDD	114		0.654 J	2.79 D	2.05 U, D	2.06 U	2.02 U	2.07 U
Endrin Aldehyde			2.01 U	2.06 U, D	2.05 U, D	2.06 U	2.02 U	2.07 U
4,4'-DDT	246		4.66	15.9 D	1.66 J, D	2.5	1.54 J	1.35 J
Endrin Ketone			2.01 U	2.06 U, D	2.05 U, D	2.06 U	2.02 U	2.07 U
Methoxychlor			2.01 U	2.06 U, D	2.05 U, D	2.06 U	2.02 U	2.07 U
NWTPH-Dx (mg/kg)								
Diesel Range	91		--	36.2 D	14.9 J, D	--	--	--
Residual Range			--	138 D	57.3 D	--	--	--
PAHs by EPA 8270-SIM (µg/kg)								
Naphthalene		561	68.4 U	388 D	39.5 J, D	344 U	33.2 J, D	6480 D
2-Methylnaphthalene		200	--	--	--	--	--	--
Acenaphthylene		200	68.4 U	176 D	69.2 U	*344 U*	55.2 U	*347 U*
Acenaphthene		300	68.4 U	164 J, D	183 D	295 J, D	171 D	1180 D
Fluorene		536	68.4 U	116 J, D	72.5 D	105 J, D	70.3 D	1240 D
Dibenzofuran			--	--	--	--	--	--
Phenanthrene		1170	137 D	1710 D	972 D	1630 D	873 D	1830 D
Anthracene		845	24.8 J, D	314 D	173 D	251 J, D	162 D	520 U
Fluoranthene		2230	400 D	5780 D	2650 D	4340 D	2110 D	139 J, D
Pyrene		1520	379 D	5490 D	1870 D	3610 D	1770 D	147 D
Benzo(b)fluoranthene			378 D	4440 D	2300 D	3560 D	1690 D	7.49 J, D
Benzo(k)fluoranthene		13000	331 D	3660 D	1270 D	3240 D	1620 D	5.34 J, D
Benzo(a)anthracene		1050	263 D	3610 D	1590 D	2810 D	1500 D	16.4 D
Chrysene		1290	357 D	4510 D	1850 D	3600 D	1720 D	24.3 D
Benzo(a)pyrene		1450	376 D	4920 D	1880 D	3610 D	1840 D	8.08 J, D
Indeno(1,2,3-cd)pyrene		100	247 D	3500 D	1220 D	1950 D	950 D	13.9 U
Dibenz(a,h)anthracene		1300	73.3 D	1060 D	427 D	662 D	322 D	13.9 U
Benzo(g,h,i)perylene		300	290 D	4160 D	1280 D	2160 D	997 D	13.9 U
BaP Eq (cPAHs)	12		544.7	7217.7	2845.4	5161.6	2603.9	10.5
PAHs (total)	23,000		--	--	--	--	--	--

Please refer to notes at end of table.

Terminal 4 Slip 1 Operable Unit 2
Riverbank Surface Soil Sampling Results
Port of Portland
Portland, Oregon

Sample ID	River Bank/ Sediment CLs	JSCS SLVs	S-28D	S-29	S-30	S-30A	S-30C	S-30D
Sample Location			T4S1S-28D	T4S1S-29	T4S1S-30	T4S1S-30A	T4S1S-30C	T4S1S-30D
Sample Type			Discrete	Discrete	Composite	Discrete	Discrete	Discrete
Sample Interval (feet)			0 - 1	0 - 1	0 - 1	0 - 1	0 - 1	0 - 1
Date Sampled			9/13/2005	9/13/2005	9/13/2005	9/13/2005	9/13/2005	38608
Operable Unit			OU2	OU2	OU2	OU2	OU2	OU2
SVOCs by EPA 8270C (µg/kg)								
Phenol		50	--	--	--	--	--	--
Di-n-butyl Phthalate		60	--	54.8 U	27.7 U	--	--	--
Bis(2-ethylhexyl) Phthalate	135		--	54.8 U	27.7 U	--	--	--
VOCs by EPA 8260B (µg/kg)								
Acetone			--	--	--	--	--	--
Carbon Disulfide			--	--	--	--	--	--
Dichloromethane (Methylene Chloride)			--	--	--	--	--	--
2-Butanone (MEK)			--	--	--	--	--	--
Chloroform			--	--	--	--	--	--
Carbon Tetrachloride			--	--	--	--	--	--
Benzene			--	--	--	--	--	--
Trichloroethene (TCE)		2100	--	--	--	--	--	--
Toluene			--	--	--	--	--	--
Tetrachloroethene (PCE)		500	--	--	--	--	--	--
Chlorobenzene			--	--	--	--	--	--
Ethylbenzene			--	--	--	--	--	--
m,p-Xylenes			--	--	--	--	--	--
o-Xylene			--	--	--	--	--	--
Isopropylbenzene			--	--	--	--	--	--
n-Propylbenzene			--	--	--	--	--	--
1,2,3-Trichlorobenzene			--	--	--	--	--	--
1,3,5-Trimethylbenzene			--	--	--	--	--	--
1,2,4-Trimethylbenzene			--	--	--	--	--	--
sec-Butylbenzene			--	--	--	--	--	--
4-Isopropyltoluene			--	--	--	--	--	--
1,4-Dichlorobenzene			--	--	--	--	--	--
n-Butylbenzene			--	--	--	--	--	--
Hexachlorobutadiene			--	--	--	--	--	--
Naphthalene			--	--	--	--	--	--
PCBs by EPA 8082 (mg/kg)								
Aroclor 1254		300	--	0.0845 U	0.0343 U	--	--	--
Aroclor 1260		200	--	0.0338 U	0.0343 U	--	--	--
Aroclor 1262			--	--	--	--	--	--
Aroclor 1268			--	--	--	--	--	--
Total PCBs	9		--	--	--	--	--	--

Notes:
1. Only detected compounds are reported in the table. The complete analyte list is presented in the Sampling and Analysis Plan (Appendix A) of the RI Work Plan (Hart Crowser, 2004a).
2. NWTPH-Dx performed with silica gel cleanup.
3. PAHs = Polynuclear Aromatic Hydrocarbons
4. SVOCs = Semi-Volatile Organic Compounds
5. VOCs = Volatile Organic Compounds
6. PCBs = Polychlorinated Biphenyls
7. mg/kg = Milligrams per kilogram.
8. µg/kg = Micrograms per kilogram.
9. -- = Not analyzed.
10. J = The result is an estimated concentration that is less than the method reporting limit (MRL) but greater than or equal to the method detection limit (MDL).
11. U = The compound was analyzed for but was not detected at or above the MRL/MDL.
12. D = The reported result is from a dilution.
13. PHSS ROD = Portland Harbor Superfund Site Record of Decision (EPA, 2017)
14. River Bank/Sediment CL = Cleanup Levels from Table 17 of PHSS ROD (EPA, 2017)
15. RALs = Remedial Action Levels from Table 21 of PHSS ROD (EPA, 2017)
16. PTW = Prinicipal Threat Waste from Table 21 of PHSS ROD (EPA, 2017)
17. Shaded values indicate that the detected concentration exceeds the River Bank/Sediment CL.
18. Italicized = method detection limit above one or more screening levels

Appendix C-2
Riverbank Soil Samples in Slip 3

Excerpts from Ash Creek 2009

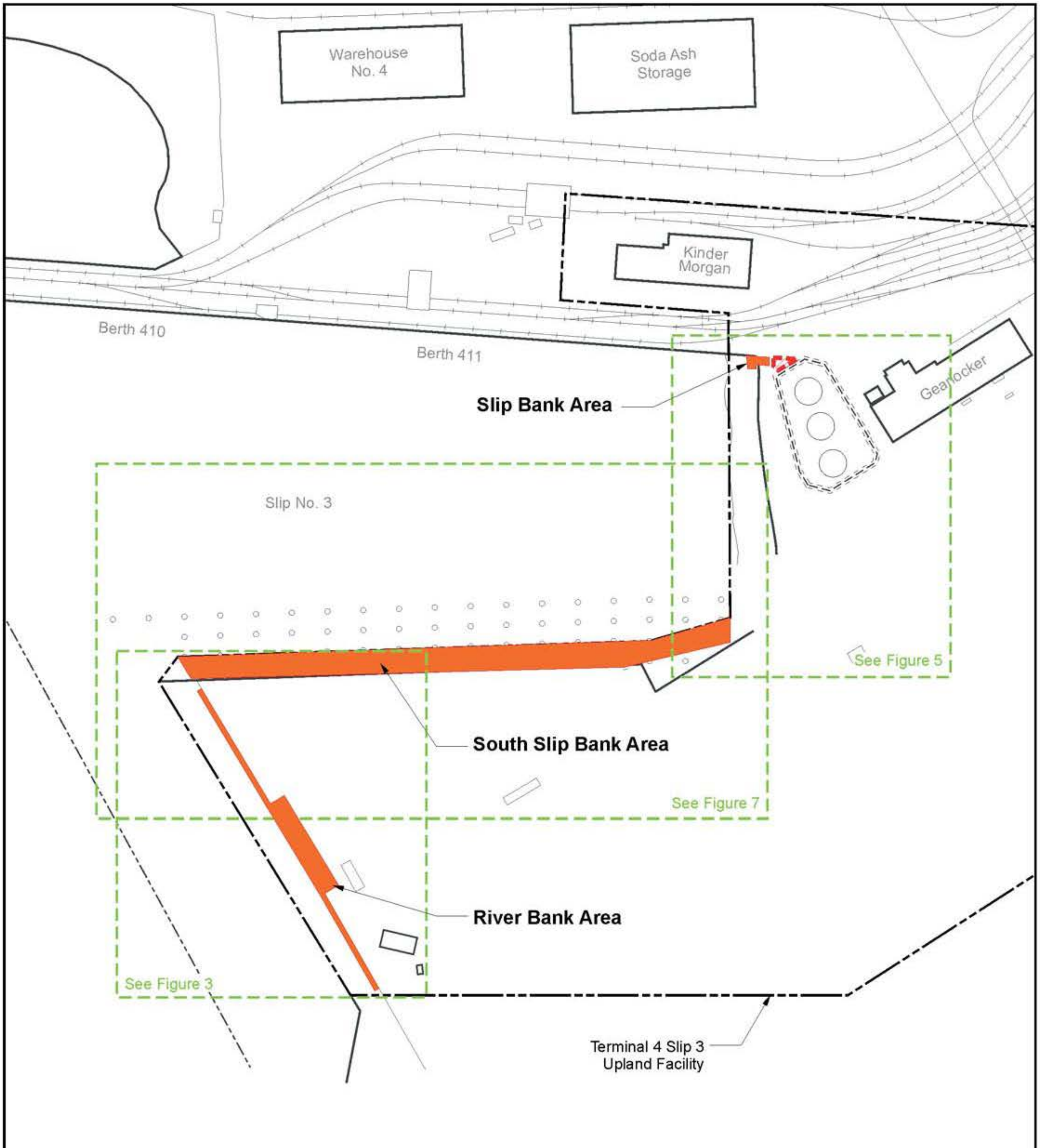
REPORT

Revised Source Control Alternatives Evaluation Terminal 4 Slip 3 Upland Facility

Port of Portland
Portland, Oregon

June 2009

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants



0 200 400
Scale in Feet

N

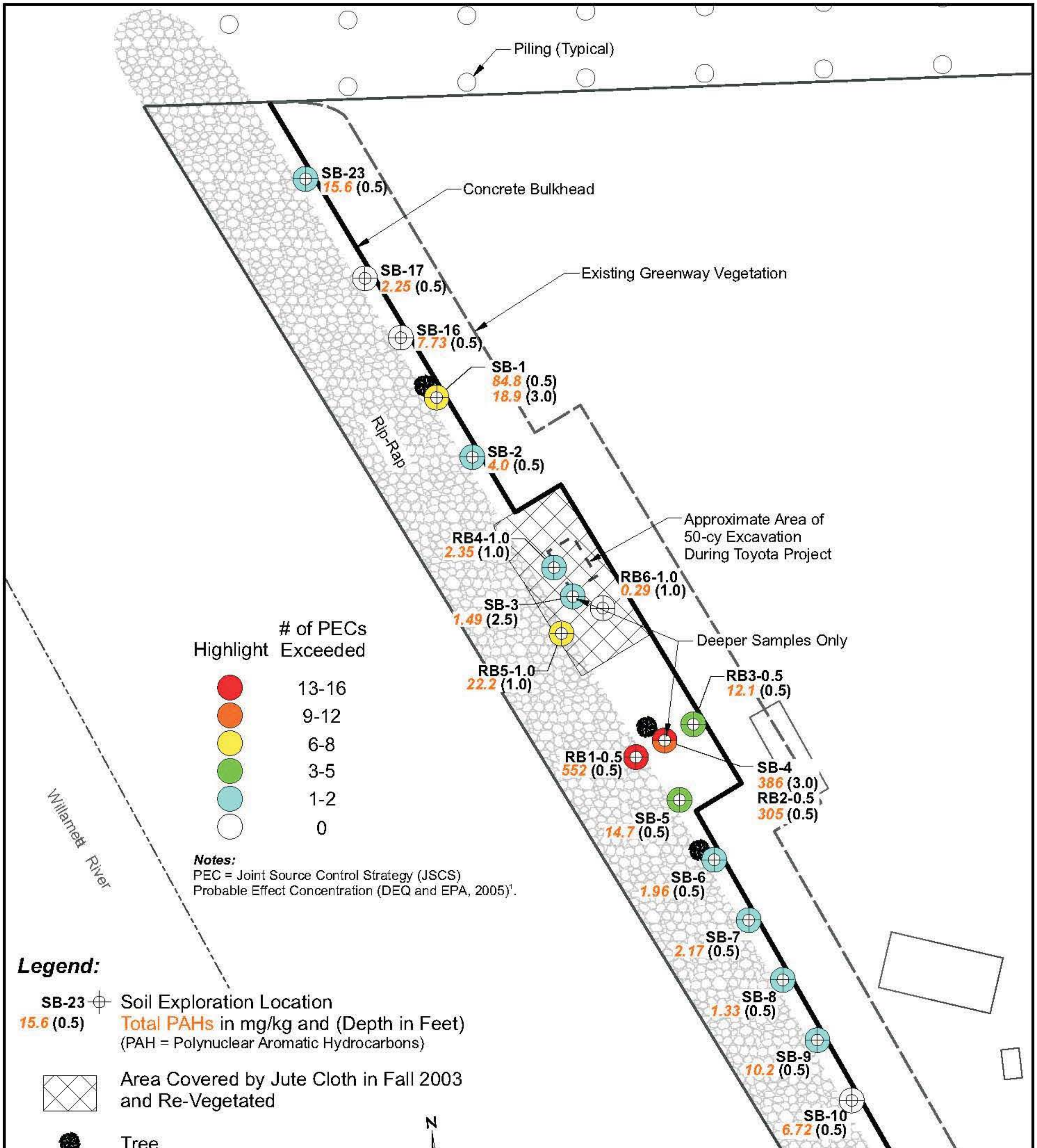
NOTE: Base map prepared from a 1998 City of Portland AutoCAD file.

Facility Vicinity Plan

Source Control Alternatives Evaluation
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number	1007-04	Figure
	June 2009	2



PAH Concentrations - River Bank Area

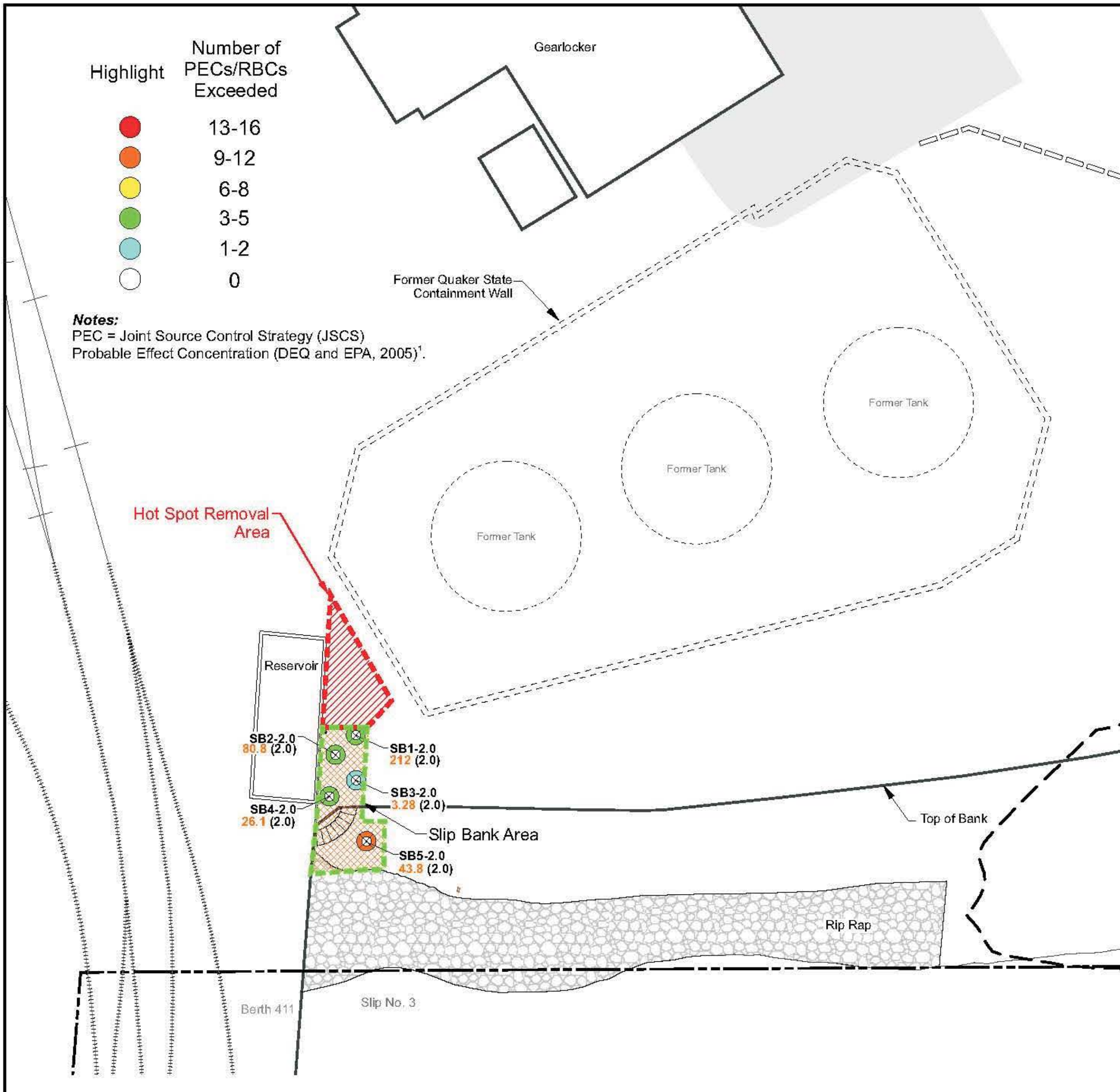
Source Control Alternatives Evaluation
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number	1007-04	Figure
June 2009		8

NOTES:

1) DEQ and EPA, 2005. Portland Harbor Joint Source Control Strategy. December 2005.
2) Enrichment Ratio = detected constituent concentration/constituent's PEC.
3) Total enrichment ratio is the sum of the enrichment ratios for all PAH constituents with concentration exceeding the PEC.
4) Base map prepared from a 1998 City of Portland AutoCAD file.



Legend:

SB2-2.0 Soil Exploration Location
15.6 (0.5) Total PAHS in mg/kg and (Depth in Feet)

Area of Proposed Source Control Measure

Paved Area

Color in Symbol Reflects Number of Constituents Exceeding PEC/RBC (Based on Color Code Below)
(Locations at which two depths were sampled is coded such that the Upper Half is for Shallow Sample and Lower Half is for Deeper Sample)

NOTES:
1) DEQ and EPA, 2005. Portland Harbor Joint Source Control Strategy. December 2005.
2) Base map prepared from a 1998 City of Portland AutoCAD file.

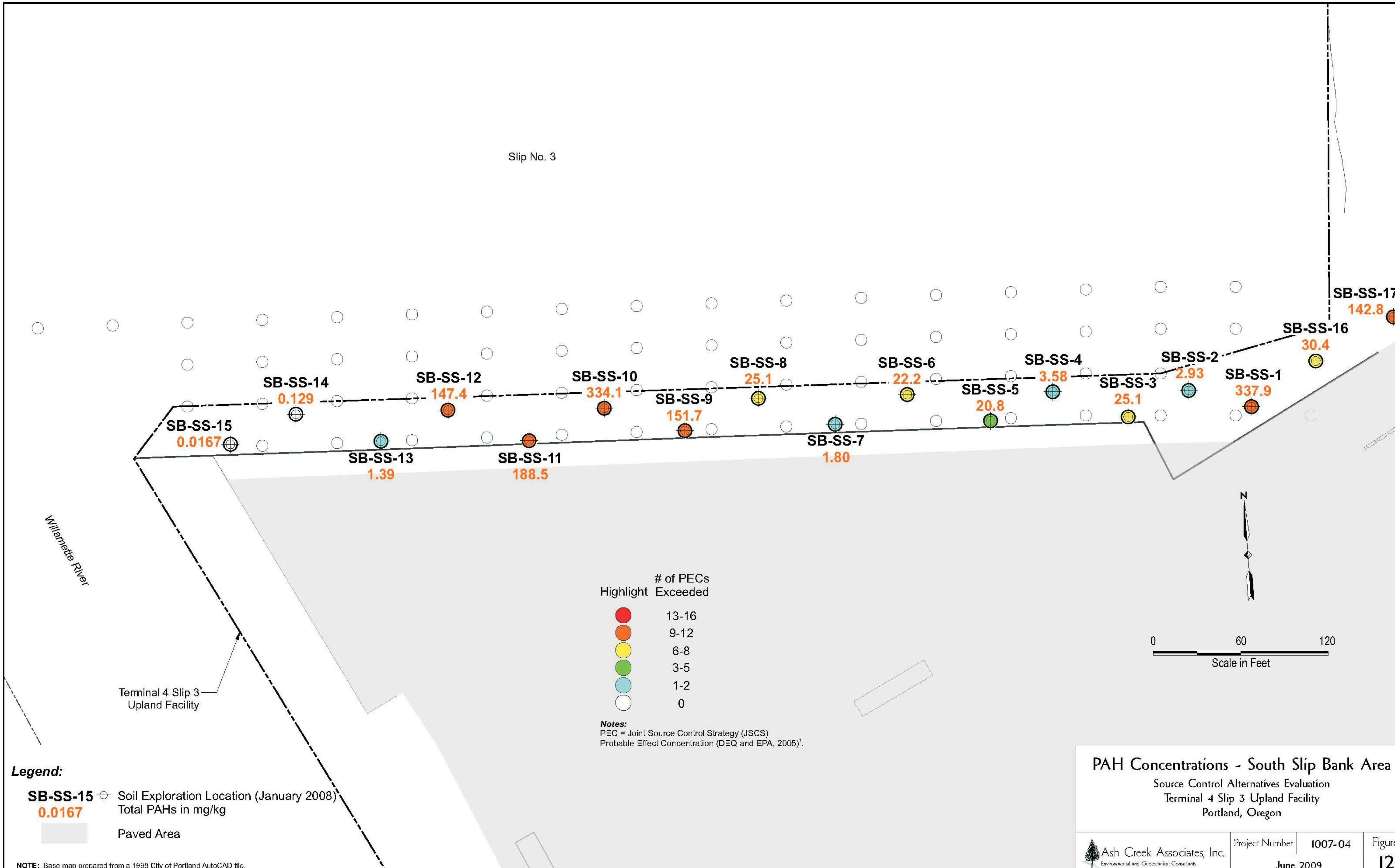
N

0 40 80
Scale in Feet

PAH Concentrations - Slip Bank Area

Source Control Alternatives Evaluation
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Ash Creek Associates, Inc. Environmental and Geotechnical Consultants	Project Number	1007-04	Figure
	June 2009		11



Notes:
PEC = Joint Source Control Strategy (JSCS)
Probable Effect Concentration (DEQ and EPA, 2005)[1].

NOTE: Base map prepared from a 1998 City of Portland AutoCAD file.

PAH Concentrations - South Slip Bank Area

Source Control Alternatives Evaluation
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Ash Creek Associates, Inc.
Environmental and Geotechnical Consultants

Project Number	1007-04	Figure
June 2009		12

Table B-1
Laboratory Analytical Results: River Bank Samples
Source Control Alternatives Analysis
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Sample ID	Date Collected	Sample Depth [feet]	Concentrations in mg/kg (ppm) Polynuclear Aromatic Hydrocarbons (PAHs)															
			Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a)pyrene	Benzo(b)-fluoranthene	Benzo(ghi)-perylene	Benzo(k)-fluoranthene	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)-pyrene	Naphthalene	Phenanthrene	Pyrene
River Bank Samples																		
T4S3PP-RB1-0.5	11/17/2005	0.5	6.37	< 0.373	8.35	51.3	50.5	60.7	29.4	41.3	54.0	14.0	90.6	3.68	28.3	1.82	48.6	63.1
T4S3PP-RB2-0.5	11/17/2005	0.5	3.98	< 0.314	5.42	35.7	36.0	45.3	22.6	27.9	38.3	10.4	59.1	2.67	21.2	0.675	32.5	44.1
T4S3PP-RB3-0.5	11/17/2005	0.5	0.107	< 0.0153	0.107	1.11	1.30	1.46	0.858	1.02	1.18	0.370	1.73	0.0608	0.779	< 0.0153	0.672	1.32
T4S3PP-RB4-1.0	11/17/2005	1	0.0186	< 0.0146	0.0204	0.212	0.277	0.257	0.112	0.214	0.279	0.0364	0.343	< 0.0146	0.114	< 0.0146	0.141	0.308
T4S3PP-RB5-1.0	11/17/2005	1	0.198	< 0.0156	0.307	1.99	2.12	2.91	1.40	1.40	2.17	0.612	3.42	0.133	1.28	0.0288	1.76	2.42
T4S3PP-RB6-1.0	11/17/2005	1	< 0.0149	< 0.0149	< 0.0149	0.0235	0.0326	0.0293	< 0.0149	0.0258	0.0312	< 0.0149	0.0351	< 0.0149	< 0.0149	< 0.0149	0.015	0.0357
SB-1-0.5	2/1/2007	0.5	< 2.83	< 2.83	< 2.83	6.36	7.60	5.57	7.71	5.59	7.85	< 2.83	11.8	< 2.83	5.68	< 2.83	< 2.83	16.7
SB-1-3	2/1/2007	3	< 0.075	0.141 J	0.165 J	1.73 J	2.05 J	2.15 J	1.57 J	1.34 J	1.76 J	0.283 J	2.72 J	< 0.075	1.28 J	0.0763 J	0.462 J	3.10 J
SB-2-0.5	2/1/2007	0.5	< 0.0738	< 0.0738	< 0.0738	0.300	0.383	0.379	0.467	0.335	0.380	0.094	0.468	< 0.0738	0.373	< 0.0738	0.165	0.474
SB-3-2.5	2/1/2007	2.5	< 0.077	< 0.077	< 0.077	0.102	0.142	0.120	0.147	0.0965	0.120	< 0.077	0.181	< 0.077	0.107	< 0.077	< 0.077	0.202
SB-4-3.0	2/1/2007	3	4.48	< 3.03	4.51	27.1	28.5	29.6	20.3	23.3	30.8	7.43	46.9	< 3.03	19.1	< 3.03	24.8	33.7
SB-5-0.5	2/1/2007	0.5	< 0.779	< 0.779	< 0.779	1.21	1.39	1.39	1.09	1.09	1.42	< 0.779	1.87	< 0.779	0.944	< 0.779	< 0.779	1.60
SB-6-0.5	2/2/2007	0.5	< 0.0736	< 0.0736	< 0.0736	0.134	0.181	0.173	0.188	0.147	0.209	< 0.0736	0.196	< 0.0736	0.149	< 0.0736	0.130	0.236
SB-7-0.5	2/2/2007	0.5	< 0.0735	< 0.0735	< 0.0735	0.184	0.226	0.213	0.180	0.201	0.205	< 0.0735	0.256	< 0.0735	0.163	< 0.0735	0.0974	0.227
SB-8-0.5	2/2/2007	0.5	< 0.0732	< 0.0732	< 0.0732	0.0857	0.121	0.109	0.180	0.0981	0.0994	< 0.0732	0.122	< 0.0732	0.132	< 0.0732	< 0.0732	0.129
SB-9-0.5	2/2/2007	0.5	< 0.072	< 0.072	0.0966	0.891	1.16	1.00	0.961	0.886	0.894	0.246	1.42	< 0.072	0.856	< 0.072	0.481	1.19
SB-10-0.5	2/2/2007	0.5	< 0.573	< 0.573	< 0.573	< 0.573	0.688	0.710	< 0.573	< 0.573	0.643	< 0.573	0.806	< 0.573	< 0.573	< 0.573	< 0.573	0.717
SB-16-0.5	3/6/2007	0.5	< 0.480	< 0.480	< 0.480	0.658	0.663	1.15	< 0.480	0.596	0.829	< 0.480	0.847	< 0.480	< 0.480	< 0.480	< 0.480	0.829
SB-17-0.5	3/6/2007	0.5	< 0.146	< 0.146	< 0.146	0.187	0.205	0.242	0.147	0.170	0.179	< 0.146	0.261	< 0.146	< 0.146	< 0.146	< 0.146	0.271
SB-23-0.5	3/6/2007	0.5	< 1.48	< 1.48	< 1.48	< 1.48	< 1.48	2.22	< 1.48	< 1.48	1.51	< 1.48	1.48	< 1.48	< 1.48	< 1.48	< 1.48	1.51
		PEC	0.30	0.20	0.845	1.05	1.45	--	0.30	13.0	1.29	1.30	2.23	0.536	0.10	0.561	1.17	1.52

Notes:
1. **Bold** values represent detected concentrations of listed analyte.
2. Shaded values represent concentrations of analyte that exceed relevant PEC.
3. PEC = Joint Source Control Strategy (JSCS) Probable Effect Concentration.
4. J = Sample held past laboratory hold time; concentration is estimated.
5. mg/kg (ppm) = Milligrams per kilogram (parts per million).

Table B-2
Enrichment Ratios: River Bank Area
Source Control Alternatives Analysis
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Sample ID	Date Collected	Sample Depth [feet]	Concentrations in mg/kg (ppm)															
			Polynuclear Aromatic Hydrocarbons (PAHs)															
			Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a)pyrene	Benzo(b)-fluoranthene	Benzo(ghi)-perylene	Benzo(k)-fluoranthene	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)-pyrene	Naphthalene	Phenanthrene	Pyrene
River Bank Samples																		
T4S3PP-RB1-0.5	11/17/2005	0.5	21	--	9.9	49	35	--	98	3.2	42	11	41	6.9	283	3.2	42	42
T4S3PP-RB2-0.5	11/17/2005	0.5	13	--	6.4	34	25	--	75	2.1	30	8.0	27	5.0	212	1.2	28	29
T4S3PP-RB3-0.5	11/17/2005	0.5	0.4	--	0.1	1.1	0.9	--	2.9	0.1	0.9	0.3	0.8	0.1	7.8	--	0.6	0.9
T4S3PP-RB4-1.0	11/17/2005	1	0.1	--	0.02	0.2	0.2	--	0.4	0.02	0.2	0.03	0.2	--	1.1	--	0.1	0.2
T4S3PP-RB5-1.0	11/17/2005	1	0.7	--	0.4	1.9	1.5	--	4.7	0.1	1.7	0.5	1.5	0.2	13	0.1	1.5	1.6
T4S3PP-RB6-1.0	11/17/2005	1	--	--	--	0.02	0.02	--	--	0.002	0.02	--	0.02	--	--	--	0.01	0.02
SB-1-0.5	2/1/2007	0.5	--	--	--	6.1	5.2	--	26	0.4	6.1	--	5.3	--	57	--	--	11
SB-1-3	2/1/2007	3	--	0.7	0.2	1.6	1.4	--	5.2	0.1	1.4	0.2	1.2	--	13	0.1	0.4	2.0
SB-2-0.5	2/1/2007	0.5	--	--	--	0.3	0.3	--	1.6	0.03	0.3	0.1	0.2	--	3.7	--	0.1	0.3
SB-3-2.5	2/1/2007	2.5	--	--	--	0.1	0.1	--	0.5	0.01	0.1	--	0.1	--	1.1	--	--	0.1
SB-4-3.0	2/1/2007	3	15	--	5.3	26	20	--	68	1.8	24	5.7	21	--	191	--	21	22
SB-5-0.5	2/1/2007	0.5	--	--	--	1.2	1.0	--	3.6	0.1	1.1	--	0.8	--	9.4	--	--	1.1
SB-6-0.5	2/2/2007	0.5	--	--	--	0.1	0.1	--	0.6	0.01	0.2	--	0.1	--	1.5	--	0.1	0.2
SB-7-0.5	2/2/2007	0.5	--	--	--	0.2	0.2	--	0.6	0.02	0.2	--	0.1	--	1.6	--	0.1	0.1
SB-8-0.5	2/2/2007	0.5	--	--	--	0.1	0.1	--	0.6	0.01	0.1	--	0.1	--	1.3	--	--	0.1
SB-9-0.5	2/2/2007	0.5	--	--	0.1	0.8	0.8	--	3.2	0.1	0.7	0.2	0.6	--	8.6	--	0.4	0.8
SB-10-0.5	2/2/2007	0.5	--	--	--		0.5	--	--	--	0.5	--	0.4	--	--	--	--	0.5
SB-16-0.5	3/6/2007	0.5	--	--	--	0.6	0.5	--	--	0.05	0.6	--	0.4	--	--	--	--	0.5
SB-17-0.5	3/6/2007	0.5	--	--	--	0.2	0.1	--	0.5	0.01	0.1	--	0.1	--	--	--	--	0.2
SB-23-0.5	3/6/2007	0.5	--	--	--	--	--	--	--	--	1.2	--	0.7	--	--	--	--	1.0
		PEC	0.30	0.20	0.845	1.05	1.45	--	0.30	13.0	1.29	1.30	2.23	0.536	0.10	0.561	1.17	1.52

Notes:
1. Enrichment Ratio = Detected Concentration / Joint Source Control Strategy (JSCS) Probable Effect Concentration (PEC).
2. Shaded values represent samples with enrichment ratios greater than 1.0.
3. -- = Analyte not detected in sample, no enrichment ratio calculated.
4. mg/kg (ppm) = Milligrams per kilogram (parts per million).

Table B-3
Laboratory Analytical Results: Slip Bank Samples
Source Control Alternatives Analysis
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Sample ID	Date Collected	Sample Depth [feet]	Concentrations in mg/kg (ppm)															
			Polynuclear Aromatic Hydrocarbons (PAHs)															
			Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a)pyrene	Benzo(b)-fluoranthene	Benzo(ghi)-perylene	Benzo(k)-fluoranthene	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)-pyrene	Naphthalene	Phenanthrene	Pyrene
Slip Bank Samples																		
T4S3PP-SB1-2.0	11/16/2005	2	2.56	< 0.285	2.33	21.5	24.1	23.5	15.2	18.7	20.1	6.48	28.1	0.831	13.8	0.383	10.2	24.3
T4S3PP-SB2-2.0	11/16/2005	2	0.758	< 0.155	0.757	7.87	9.08	9.76	5.79	6.52	7.85	2.39	11.3	0.309	5.21	0.162	3.63	9.38
T4S3PP-SB3-2.0	11/16/2005	2	0.0343	< 0.0165	0.0343	0.299	0.386	0.304	0.180	0.256	0.366	0.0506	0.483	0.0182	0.176	0.0213	0.182	0.484
T4S3PP-SB4-2.0	11/16/2005	2	0.273	< 0.0154	0.409	2.54	2.76	2.96	1.87	2.00	2.38	0.78	3.68	0.102	1.69	0.0567	1.64	2.96
T4S3PP-SB5-2.0	11/16/2005	2	0.582	< 0.0155	0.673	4.51	3.90	4.75	2.37	3.06	4.40	1.16	6.46	0.549	2.27	0.111	4.18	4.86
		PEC	0.30	0.20	0.845	1.05	1.45	--	0.30	13.0	1.29	1.30	2.23	0.536	0.10	0.561	1.17	1.52

Notes:
1. **Bold** values represent detected concentrations of listed analyte.
2. Shaded values represent concentrations of analyte that exceed relevant Risk-Based Concentration (RBC) for upland soil or the PEC for erodible soil.
3. PEC = Joint Source Control Strategy (JSCS) Probable Effect Concentration.
4. mg/kg (ppm) = Milligrams per kilogram (parts per million).
5. -- = Analyte not detected in sample, no enrichment ratio calculated.

Table B-4
Enrichment Ratios: Slip Bank Area
Source Control Alternatives Analysis
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Sample ID	Date Collected	Sample Depth [feet]	Concentrations in mg/kg (ppm)															
			Polynuclear Aromatic Hydrocarbons (PAHs)															
			Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a)pyrene	Benzo(b)-fluoranthene	Benzo(ghi)-perylene	Benzo(k)-fluoranthene	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)-pyrene	Naphthalene	Phenanthrene	Pyrene
Slip Bank Samples																		
T4S3PP-SB1-2.0	11/16/2005	2.0	8.5	--	2.8	20.5	16.6	--	50.7	1.4	15.6	5.0	12.6	1.6	138.0	0.7	8.7	16.0
T4S3PP-SB2-2.0	11/16/2005	2.0	2.5	--	0.9	7.5	6.3	--	19.3	0.5	6.1	1.8	5.1	0.6	52.1	0.3	3.1	6.2
T4S3PP-SB3-2.0	11/16/2005	2.0	0.1	--	0.04	0.3	0.3	--	0.6	0.02	0.3	0.04	0.2	0.03	1.8	0.04	0.2	0.3
T4S3PP-SB4-2.0	11/16/2005	2.0	0.9	--	0.5	2.4	1.9	--	6.2	0.2	1.8	0.6	1.7	0.2	16.9	0.1	1.4	1.9
T4S3PP-SB5-2.0	11/16/2005	2.0	1.9	--	0.8	4.3	2.7	--	7.9	0.2	3.4	0.9	2.9	1.0	22.7	0.2	3.6	3.2
		PEC	0.30	0.20	0.845	1.05	1.45	--	0.30	13.0	1.29	1.30	2.23	0.536	0.10	0.561	1.17	1.52

Notes:
1. Enrichment Ratio = Detected Concentration / Joint Source Control Strategy (JSCS) Probable Effect Concentration (PEC).
2. Shaded values represent samples with detected concentrations exceeding relevant PEC.
3. -- = Analyte not detected in sample, no enrichment ratio calculated.
4. mg/kg (ppm) = Milligrams per kilogram (parts per million).

Table B-5
Laboratory Analytical Results: South Slip Bank Samples
Source Control Alternatives Analysis
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Sample ID	Date Collected	Sample Depth [feet]	Concentrations in mg/kg (ppm)															
			Polynuclear Aromatic Hydrocarbons (PAHs)															
			Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a)pyrene	Benzo(b)-fluoranthene	Benzo(ghi)-perylene	Benzo(k)-fluoranthene	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)-pyrene	Naphthalene	Phenanthrene	Pyrene
South Slip Bank Samples																		
SB-SS-1	1/24/2008	0.5	< 3.23	< 3.23	4.33	30.0	36.7	23.1	30.6	24.4	36.3	5.00	55.1	< 3.23	24.5	< 3.23	13.4	54.5
SB-SS-2	1/24/2008	0.5	< 0.145	< 0.145	< 0.145	0.171	0.168	0.543	0.271	0.292	0.447	< 0.145	0.368	< 0.145	0.265	< 0.145	0.153	0.255
SB-SS-3	1/24/2008	0.5	< 1.43	< 1.43	< 1.43	2.31	3.08	3.21	2.56	2.51	2.89	< 1.43	3.55	< 1.43	2.43	< 1.43	< 1.43	2.57
SB-SS-4	1/24/2008	0.5	< 0.153	< 0.153	< 0.153	0.280	0.403	0.348	0.476	0.285	0.406	< 0.153	0.485	< 0.153	0.367	< 0.153	< 0.153	0.525
SB-SS-5	1/24/2008	0.5	< 0.708	< 0.708	0.845	1.83	1.82	2.61	2.36	22.11	3.05	< 0.708	1.89	< 0.708	2.08	< 0.708	0.789	1.38
SB-SS-6	1/24/2008	0.5	< 0.774	< 0.774	< 0.774	1.83	2.35	2.00	2.52	1.97	2.35	< 0.774	3.27	< 0.774	2.08	< 0.774	1.21	2.67
SB-SS-7	1/24/2008	0.5	< 0.0143	0.0202	0.0240	0.141	0.195	0.155	0.194	0.138	0.169	0.0344	0.256	< 0.0143	0.158	< 0.0143	0.0501	0.263
SB-SS-8	1/24/2008	0.5	< 0.292	< 0.292	0.408	2.00	2.31	1.60	2.18	1.70	2.39	0.366	4.65	< 0.292	1.69	< 0.292	1.09	4.67
SB-SS-9	1/24/2008	0.5	< 1.43	< 1.43	< 1.43	12.7	17.1	11.4	15.3	10.60	14.8	2.46	24.5	< 1.43	11.7	< 1.43	3.72	27.4
SB-SS-10	1/24/2008	0.5	< 2.97	< 2.97	3.63	26.5	36.0	25.0	31.0	21.70	32.6	4.95	57.2	< 2.97	23.9	< 2.97	10.1	61.5
SB-SS-11	1/24/2008	0.5	< 1.47	1.53	1.69	15.5	20.8	12.8	16.5	13.80	18.4	2.81	31.3	< 1.47	13.0	< 1.47	4.05	36.3
SB-SS-12	1/24/2008	0.5	< 1.46	< 1.46	< 1.46	12.5	16.5	11.0	14.5	11.80	16.0	2.44	23.2	< 1.46	112	< 1.46	4.51	23.8
SB-SS-13	1/24/2008	0.5	< 0.0142	< 0.0142	0.0276	0.113	0.133	0.156	0.108	0.13	0.147	0.0307	0.210	< 0.0142	0.103	< 0.0142	0.0931	0.147
SB-SS-14	1/24/2008	0.5	< 0.0146	< 0.0146	< 0.0146	< 0.0146	0.0190	0.0189	0.0167	< 0.0146	0.0191	< 0.0146	0.0290	< 0.0146	< 0.0146	< 0.0146	< 0.0146	0.0261
SB-SS-15	1/24/2008	0.5	< 0.0144	< 0.0144	< 0.0144	< 0.0144	< 0.0144	< 0.0144	< 0.0144	< 0.0144	< 0.0144	< 0.0144	0.0167	< 0.0144	< 0.0144	< 0.0144	< 0.0144	< 0.0144
SB-SS-16	1/24/2008	0.5	< 1.47	< 1.47	< 1.47	2.64	3.23	3.42	2.62	2.56	3.49	< 1.47	4.14	< 1.47	2.30	< 1.47	1.61	4.42
SB-SS-17	1/24/2008	0.5	< 0.716	< 0.716	1.33	13.3	14.80	10.2	9.11	9.67	15.70	1.76	25.0	< 0.716	7.93	< 0.716	4.26	29.7
		PEC	0.30	0.20	0.845	1.05	1.45	--	0.30	13.0	1.29	1.30	2.23	0.536	0.10	0.561	1.17	1.52

Notes:
1. **Bold** values represent detected concentrations of listed analyte.
2. Shaded values represent concentrations of analyte that exceed relevant Risk-Based Concentration (RBC) for upland soil or the PEC for erodible soil.
3. PEC = Joint Source Control Strategy (JSCS) Probable Effect Concentration.
4. mg/kg (ppm) = Milligrams per kilogram (parts per million).
5. -- = Analyte not detected in sample, no enrichment ratio calculated.

Table B-6
Enrichment Ratios: South Slip Bank Area
Source Control Alternatives Analysis
Terminal 4 Slip 3 Upland Facility
Portland, Oregon

Sample ID	Date Collected	Sample Depth [feet]	Concentrations in mg/kg (ppm) Polynuclear Aromatic Hydrocarbons (PAHs)															
			Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a)pyrene	Benzo(b)-fluoranthene	Benzo(ghi)-perylene	Benzo(k)-fluoranthene	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)-pyrene	Naphthalene	Phenanthrene	Pyrene
South Slip Bank Samples																		
SB-SS-1	1/24/2008	0.5	--	--	5.1	28.6	25.3	--	102.0	1.9	28.1	3.8	24.7	--	245	--	11.5	35.9
SB-SS-2	1/24/2008	0.5	--	--	--	0.2	0.1	--	0.9	0.02	0.3	--	0.2	--	2.7	--	0.1	0.2
SB-SS-3	1/24/2008	0.5	--	--	--	2.2	2.1	--	8.5	0.2	2.2	--	1.6	--	24.3	--	--	1.7
SB-SS-4	1/24/2008	0.5	--	--	--	0.3	0.3	--	1.6	0.02	0.3	--	0.2	--	3.7	--	--	0.3
SB-SS-5	1/24/2008	0.5	--	--	1.0	1.7	1.3	--	7.9	1.7	2.4	--	0.8	--	20.8	--	0.7	0.9
SB-SS-6	1/24/2008	0.5	--	--	--	1.7	1.6	--	8.4	0.2	1.8	--	1.5	--	20.8	--	1.0	1.8
SB-SS-7	1/24/2008	0.5	--	0.1	0.03	0.1	0.1	--	0.6	0.01	0.1	0.03	0.1	--	1.6	--	0.04	0.2
SB-SS-8	1/24/2008	0.5	--	--	0.5	1.9	1.6	--	7.3	0.1	1.9	0.3	2.1	--	16.9	--	0.9	3.1
SB-SS-9	1/24/2008	0.5	--	--	--	12.1	11.8	--	51.0	0.8	11.5	1.9	11.0	--	117	--	3.2	18.0
SB-SS-10	1/24/2008	0.5	--	--	4.3	25.2	24.8	--	103.3	1.7	25.3	3.8	25.7	--	239	--	8.6	40.5
SB-SS-11	1/24/2008	0.5	--	7.7	2.0	14.8	14.3	--	55.0	1.1	14.3	2.2	14.0	--	130	--	3.5	23.9
SB-SS-12	1/24/2008	0.5	--	--	--	11.9	11.4	--	48.3	0.9	12.4	1.9	10.4	--	1,120	--	3.9	15.7
SB-SS-13	1/24/2008	0.5	--	--	0.03	0.1	0.1	--	0.4	0.01	0.1	0.02	0.1	--	1.0	--	0.1	0.1
SB-SS-14	1/24/2008	0.5	--	--	--	--	0.01	--	0.1	--	0.01	--	0.01	--	--	--	--	0.02
SB-SS-15	1/24/2008	0.5	--	--	--	--	--	--	--	--	--	--	0.01	--	--	--	--	--
SB-SS-16	1/24/2008	0.5	--	--	--	2.5	2.2	--	8.7	0.2	2.7	--	1.9	--	23.0	--	1.4	2.9
SB-SS-17	1/24/2008	0.5	--	--	1.6	12.7	10.2	--	30.4	0.7	12.2	1.4	11.2	--	79.3	--	3.6	19.5
		PEC	0.30	0.20	0.845	1.05	1.45	--	0.30	13.0	1.29	1.30	2.23	0.536	0.10	0.561	1.17	1.52

Notes:
1. Enrichment Ratio = Detected Concentration / Joint Source Control Strategy (JSCS) Probable Effect Concentration (PEC).
2. Shaded values represent samples with detected concentrations exceeding relevant PEC.
3. -- = Analyte not detected in sample, no enrichment ratio calculated.
4. mg/kg (ppm) = Milligrams per kilogram (parts per million).
5. **Bold** values represent detected concentrations of listed analyte.